

**Phonetic Aspects of the Lower Cross Languages**  
**and**  
**Their Implications for Sound Change**

**Bruce A. Connell**



**PhD.**  
**University of Edinburgh**  
**1991**

## Declaration

I declare that this thesis has been written by myself and that the research herein has been conducted by myself, except where otherwise indicated. Certain material in a number of chapters has been presented at conferences or has appeared in *Work in Progress*, Department of Linguistics, University of Edinburgh. Reference is given in the appropriate places.

Bruce Connell

Oxford, July 1, 1991



## Acknowledgements

Huge debts of gratitude are owed to a great many people, without whom this work would never have even reached the gestation stage, let alone fruition. On the academic side, one's first acknowledgement always goes to one's supervisor, and in this case deservedly so. Alan Kemp's interest in and knowledge of phonetics have served me well; these have only been over-shadowed by his patience and his understanding of the tribulations of dissertation writing. To all those with whom I discussed the many aspects of this work, I am also grateful. In Edinburgh, Bob Ladd, Helen Fraser and my office-mate, Anna Gavarró and our friend Paul MacIlvenney deserve special mention. In Africa, especially Kay Williamson, Okon Essien, and Phil Noss deserve mention for their academic support and encouragement. Between the U.K. and Africa, in the Netherlands, Tom Cook must be singled out for special thanks, for his constant readiness to discuss, via e-mail, any aspect of Lower Cross linguistics.

A fieldworker owes perhaps an even greater debt to his assistants and informants; in my own case this is doubly true. My students, friends, and colleagues in Calabar were always ready to assist in any way possible, but more than providing me with linguistic help, they instilled in me a love for Africa, its people, and their languages. They are far too many to mention here, and though I have forgotten none of them I can mention but a few: Glory Ibiok and Paulinus Noah, are first and foremost. Kojo Maison, Irene Inem, Uche Aaron, Bassey Akpanudo, Ikpa Antigha, Helen Bassey, Paul Dan, Edet Ekeng, Imo Eshiet, Benjamin Etuk, Angela Idem, Daniel Hanson, Cletus Motina, Hannah Peters, and Ruby Williams all contributed in many ways to the collection of the data used here. Encouragement and support came from them as well as many others, in particular Nene Ilonah. Also for their kind cooperation, I remember Ekaete Umoete and her family, Etim Uno, Chief Efiong Ubuoyo, Chief Adiakpan, Chief A. Abia, Ikwa Essien, Rex Ulaeto, Chief U. Akpan, Chief Okon Ekpong Inyang, Sunday Ikare Dick, Tallick George, Sunday Udo Obong, Uma Ukpe, B. Belejit, Lawrence Bassey, Uduak Bassey, Chief Okon Ekpenyong Inyang, and Chief Isoni.

For technical assistance, I am particularly appreciative of the cooperation received from Cedric MacMartin, Stewart Smith, Morag Brown and Irene MacLeod in the Department of Linguistics at Edinburgh, and to Celia Glyn at the Phonetics Laboratory at

Oxford University for help with the typing, and to David Zeitlyn for help in solving the 'appendicitis'.

For financial assistance, I am grateful to the University of Edinburgh for a Vans Dunlop Scholarship, which enabled me to embark on this prolonged project and kept it and me going for three years.

Finally, to my family, for their support, both financial and moral, their confidence, and patience in waiting.

## Abstract

The study of sound change has been an important area of study in Linguistics throughout the modern era of the discipline. The approach taken to its examination, however, has varied considerably over the years, and it is only recently that phonetics has begun to fit seriously again into the equation. In this dissertation, an exploration of certain consonantal sound changes observed in the Lower Cross languages of South-Eastern Nigeria is presented, taking as basic the assumption that a detailed knowledge of the phonetic characteristics of the languages in question and of general phonetic theory are essential in coming to grips with the phenomena of sound change.

In order to achieve the desired aim of the dissertation it has been necessary first to provide an adequate phonetic description, since the Lower Cross languages are for the most part previously undescribed. This is done placing primary, but by no means exclusive, emphasis on Ibibio, the largest language of the group. A variety of instrumental investigations (spectrography, aerometry, electropalatography, laryngography), as well as an impressionistic analysis, were conducted into the phonetics of this language, using a number of different speakers. Among the results of these investigations is a detailed description of the production of the labial-velar stop of Ibibio, to my knowledge the most detailed report on these stops to date, for any language. Description of the other languages of the group is primarily, but not exclusively, impressionistic in nature.

To investigate the sound changes found in these languages, it has also been necessary to reconstruct the consonant system of their latest common ancestor, Proto-Lower Cross. For the most part, this reconstruction was arrived at with a high degree of confidence, however it is recognized that in the absence of an adequate reconstruction of the vowel system, certain aspects of the consonant reconstruction, at least, must be considered tentative.

The description of the phonetics of the Lower Cross languages, and in particular the instrumental investigations of Ibibio, is then used to examine the observed consonantal sound changes. This is done using a phonetic approach to sound change based in the principles of signal detection theory, which suggests that the speech signal may be perturbed by 'noise' at various places during the transmission process, from encoding and production to perception and decoding. Emphasis in the present work is on exploring

perturbations during production, which leads to consideration of an alternative theory of sound change, known as Articulatory Evolution. These two phonetically-based theories of sound change are then examined in light of the Lower Cross data, to determine to what extent they must be viewed as competing theories, or whether they in any way complement each other. This is done through considering the implications of the two for a number of long standing issues with regard to sound change, in particular the graduality controversy and the role of perception in sound change. It is concluded that although these two theories have been considered to be competing by their adherents, with regard to production they may to a large extent, be seen as complementary. With regard to the role of perception in sound change, the area of least common ground between the two, both are found wanting.

## Symbols

Phonetic symbols used in this work conform to the conventions of the International Phonetic Association. The following, however, are slightly exceptional:

[ɽ] represents a tapped voiced uvular stop or approximant, not a voiced uvular trill.

The diacritic [̣] used over a consonant symbol represents a tapped articulation of that consonant.

Downstepping of tones is indicated with ‘ ! ’.

The symbol [j] is used to represent both a voiced palatal approximant and a voiced palatal fricative. On occasion, where it has been necessary to make clear it is the fricative that is being referred to, a diacritic has been added, i.e., [j̣].

Generally, transcriptions are either phonetic or phonemic, as indicated by the appropriate bracketting. For Efik and Ibibio, their standard orthography is also occasionally used, with that of Efik modified only by including tone marks.

## Table of Contents

<b>Introduction.....</b>	<b>1</b>
0.1. Aims of the Dissertation.....	1
0.2. The Lower Cross Languages .....	3
0.2.1. Geographical considerations .....	3
0.2.2. Demographic considerations .....	7
0.2.3. Language and dialect .....	8
0.2.4. Linguistic interaction in the Lower Cross region. ....	9
0.2.5. Genetic affiliations.....	10
0.2.6. Previous studies .....	12
0.3. Informants and Data .....	13
 <b>Chapter One.....</b>	 <b>15</b>
<b>Phonetics and Sound Change.....</b>	<b>15</b>
1.1. What Constitutes Sound Change.....	15
1.1.1. Sound change as a phonetic process .....	16
1.1.2. Sound change as a phonological phenomenon.....	17
1.1.3. Sociolinguistic investigation of sound change .....	19
1.1.4. Distinguishing different aspects of sound change .....	20
1.2. A Theoretical Framework for Investigating Sound Change.....	21
1.3. Javkin's Taxonomy.....	22
1.3.1. Type 1	
Articulatory-based changes.....	23
1.3.2. Type 2	
Articulatory-based changes.....	23
1.3.3. Type 3	
Acoustically-based changes .....	23
1.3.4. Type 4	
Auditory-based changes .....	24
1.3.5. Discussion of Javkin's taxonomy .....	24
1.3.6. Summary .....	26

1.4.	Catford's Taxonomy.....	26
1.5.	A Proposed Taxonomy of Sound Change .....	29
1.6.	Graduality and Abruptness of Sound Change .....	30
1.7.	Ease of Articulation .....	33
1.8.	The Role of the Listener.....	34
1.9.	Sound Change, Phonetics, and Phonology.....	37
<b>Chapter Two</b> .....		<b>39</b>
<b>An Overview of Lower Cross Phonology.....</b>		<b>39</b>
2.0.	Introduction.....	39
2.1.	Lower Cross Consonants .....	40
2.1.1.	Distribution and realization of consonants in initial position .....	40
2.1.2.	Final position.....	42
2.1.3.	Intervocalic (ambisyllabic) position .....	43
2.2.	Vowel and Tone Systems in Lower Cross.....	44
2.2.1.	Vowels.....	44
2.2.2.	Tone.....	46
2.3.	Consonants and Syllable Structures .....	47
2.3.1.	Analyses of Ibibio phonology.....	47
2.3.1.1.	Kaufman (1968).....	47
2.3.1.2.	Boys (1979) .....	48
2.3.2.	Oro .....	49
2.3.3.	Efik.....	50
2.3.3.1.	The Efik syllabeme.....	50
2.3.3.2.	The Distribution of Efik consonants and its relation to syllable structure .....	51
2.3.3.3.	The open transition and the syllabeme.....	54
2.4.	Syllable Structures in Lower Cross.....	57
2.4.1.	Internal structure of LC syllables.....	57
2.4.2.	Syllables and feet.....	58
2.5.	Morphosyntactic Considerations .....	59
2.6.	Conclusion.....	60
<b>Chapter Three</b> .....		<b>61</b>
<b>The Phonetics of Lower Cross Consonants with Particular Reference to Ibibio .....</b>		<b>61</b>
3.0.	Introduction.....	61



3.1. The Description and Classification of Consonants.....	62
3.2. Articulatory Characteristics of Ibibio Consonants.....	64
3.2.1. Labials .....	64
3.2.2. Labiodentals.....	65
3.2.3. Alveolars.....	65
3.2.4. Palatals.....	68
3.2.5. Velars .....	69
3.2.6. Labialized velars .....	70
3.2.7. Labial-velars.....	70
3.2.8. Homorganic Nasals .....	71
3.3. Instrumentation and Methodology .....	71
3.3.1. Instrumentation .....	71
3.3.2. Methodology .....	75
3.4. Voicing Characteristics.....	78
3.4.1 Introduction .....	78
3.4.2. Voiced and voiceless stops in Ibibio .....	79
3.4.3. Hypotheses regarding voicing control .....	82
3.4.4. Ibibio voiceless unaspirated stops.....	86
3.4.4.1. Procedure .....	86
3.4.4.3. Discussion .....	90
3.5. Investigations using Electropalatography .....	95
3.5.1. Introduction .....	95
3.5.2. Spatial coarticulation in symmetrical vowel contexts.....	98
3.5.3. Summary of spatial coarticulation (symmetrical vowel contexts).....	102
3.5.4. Interlude:	
possible effects of word structure .....	103
3.5.5. Spatial coarticulation in asymmetrical vowel contexts.....	104
3.5.6. Summary .....	106
3.5.7. Dynamic aspects of coarticulation .....	107
3.5.8. Temporal coarticulation (symmetrical environments) .....	108
3.5.9. Summary of temporal coarticulation (symmetrical environments).....	112
3.5.10. Asymmetrical environments .....	113
3.5.11. Closing gesture.....	113
3.5.12. Duration of constriction .....	115
3.5.13. Opening gesture .....	115
3.5.14. Vowel to vowel coarticulation .....	116
3.6. The Ibibio Labial-velar Stop .....	118



3.6.1. Introduction .....	118
3.6.2. Notes on previous work .....	119
3.6.2.1. Impressionistic reports .....	119
3.6.2.2. Articulatory characteristics .....	120
3.6.2.3. Acoustic structure .....	121
3.6.3. Impressionistic description of Ibibio labial-velars .....	123
3.6.4. Instrumental investigations .....	123
3.6.4.1. Acoustic structure .....	123
3.6.4.2. Burst spectra.....	134
3.6.4.3. Voicing characteristics.....	134
3.6.4.4. Temporal aspects.....	136
3.6.4.5. Aerometry and laryngography.....	137
3.6.4.6. Electropalatography and laryngography.....	140
3.6.5. Summary and conclusions.....	144
3.7. Phonetic Characteristics of the Consonants of the Lower Cross Languages.....	148
3.7.1. Introduction .....	148
3.7.2. Labials .....	149
3.7.3. Labiodentals.....	151
3.7.4. Alveolars.....	152
3.7.5. Palatals.....	157
3.7.6. Velars .....	160
3.7.7. Labialized velars .....	160
3.7.8. Labial-velars.....	161
3.7.9. Voicing characteristics .....	167
3.7.10. Consonants in final position.....	169
3.7.11. Consonants in ambisyllabic position.....	170
3.7.12. Summary.....	171
<b>Chapter Four.....</b>	<b>173</b>
<b>The Historical Development of Lower Cross Consonants.....</b>	<b>173</b>
4.1. Introduction.....	173
4.2. The Consonant System of Proto-Lower Cross.....	174
4.2.1. A fortis/lenis opposition in Lower Cross?.....	176
4.2.2. The nasal series .....	177
4.2.3. Labials .....	183
4.2.4. The development of alveolar stops .....	186

4.2.5. The /d/ - /l/ - /n/ correspondence and the phonemic status of */l/ in PLC.....	189
4.2.6. Palatals.....	193
4.2.7. Voiceless velar stops.....	196
4.2.7. Labial-velar stops.....	199
4.2.8. Labialized velar stops .....	203
4.3. Fricatives.....	205
4.3.1. Labials .....	205
4.3.2. Alveolars.....	205
4.4. Approximants.....	208
4.5. Proto-Lower Cross Consonants in Ambisyllabic Position.....	209
4.6. PLC consonants in Final (Pre-pausal) Position .....	210
4.7. Implications for Sub-grouping Within Lower Cross .....	211
4.8. Summary.....	213

## **Chapter Five .....216**

### **The Phonetic Basis of Consonantal Developments in Lower Cross.....216**

5.1. Introduction.....	216
5.1.1. Articulatory Evolution.....	217
5.1.2. Contributions from Lower Cross.....	218
5.2. Gradual Change and Developments in the PLC Consonant System.....	220
5.2.1. PLC *d and Ibibio alveolars.....	220
5.2.2. Perceptual interlude.....	226
5.2.3. Gradual change in Ibibio? .....	228
5.2.4. The [r] to [l] development in Anaang.....	228
5.2.5. The merger of PLC *d and *l.....	229
5.2.6. Development of PLC palatals .....	229
5.2.7. The erosion of PLC *g <sup>w</sup> .....	231
5.2.8. Other instances of substantive reduction.....	233
5.3. Developments of PLC *kp.....	236
5.4. Voicing Developments.....	238
5.4.1. [-voice] becomes [+voice].....	238
5.4.2. [+voice] becomes [-voice].....	242
5.4.3. Voicing developments and Articulatory Evolution.....	243
5.5. Other Developments in Lower Cross Consonantal Systems.....	245
5.5.1. Consonants in ambisyllabic position.....	245
5.5.2. Attrition of final consonants.....	245
5.6. Summary.....	247

<b>Chapter Six.....</b>	<b>249</b>
<b>Conclusions.....</b>	<b>249</b>
6.1. Introduction.....	249
6.2. Phonetic Description.....	249
6.2.1. Articulatory considerations .....	250
6.2.2. Voicing characteristics .....	252
6.2.3. Electropalatography .....	252
6.2.4. Labial-velars.....	253
6.4. Sound Change in Lower Cross and Contributions to a General Theory of Sound Change .....	255
6.5. Directions for Future Research .....	258
<b>References.....</b>	<b>260</b>
<b>Appendix A.....</b>	<b>272</b>
<b>Comparative Wordlists.....</b>	<b>272</b>
A.0. Introduction and Notes on the Wordlists .....	272
<b>Appendix B.....</b>	<b>345</b>
<b>Palatograms, Stomatograms, and EPG Charts of Ibibio Consonant Articulation.....</b>	<b>345</b>
B.0. Introduction .....	345
<b>Appendix C.....</b>	<b>393</b>
<b>Speech Materials Used in Instrumental Investigations .....</b>	<b>393</b>
C.0. Introduction .....	393
C.1. Wordlist Used in the Spectrographic Investigation.....	393
C.2. Wordlist Used for Aerometry x Lx Investigation.....	394
C.3. Wordlist Used for EPG x Lx Investigation.....	395

Ídùòt ódùk ọfọṣ úsùk úsùk.

# **Phonetic Aspects of Consonantal Sound Change in the Lower Cross Languages**

## **Introduction**

### **0.1. Aims of the dissertation**

Sound change can be examined from a variety of perspectives; broadly speaking these can be grouped as the phonetic, the phonological (or psychological) and the sociolinguistic. This dissertation is intended, first of all, as an investigation into the phonetic bases of consonantal sound change. However, even within the domain of phonetics, different approaches to sound change are possible, so in Chapter One various issues of concern to setting an appropriate theoretical background for the present study are discussed.

Both speech production and perception have been said to play an important role in sound change, though the relation between these two aspects of speech and their relative importance with regard to sound change is not clear. Traditionally (i.e., going back to the Neogrammarians) greater emphasis has been placed on articulatory aspects, though more recently, for many researchers (e.g., Ohala 1981, 1989) perception has come to be considered more important. This view comes, in large part, from the belief that acoustic similarities shared by different sounds can lead to perceptual confusion, which in turn may result in sound change. Ohala (1983, 1989) also agrees, though, that physiological constraints inherent in the vocal tract can lead to change. Pagliuca and Mowrey (1980, 1987), on the other hand, take exception to the view that perception plays an important role (or indeed any role at all), maintaining emphasis on

articulation. It is aspects of speech production rather than perception which are of greater concern in this dissertation.

The data for the study are drawn from the Lower Cross languages of South-Eastern Nigeria which are, for the most part, previously undescribed. It is therefore necessary to provide some background concerning the languages of this group. In particular, a certain amount of insight into the phonology of these languages will be useful to the reader, and therefore Chapter Two summarizes previous phonological work on the languages of the group, as well as contributing new observations. No explicit attempt is made to solve the many interesting questions which arise that would be of importance to the theoretical phonologist; these are, unfortunately, outside the scope of the present work, and must be examined at a later date. However, effort is made to present and justify generalizations concerning phonological structures considered common to the group.

More important than the phonological statement, for our present purposes, is an account of the consonantal phonetics of these languages. This is presented in Chapter Three, first through a detailed examination - both impressionistic and instrumental - of the consonantal phonetics of Ibibio, the largest language of the group. The impressionistic description is presented first, followed by discussion of the instrumental work, which involved use of spectrography, aerometry, laryngography and electropalatography. One section of the chapter is devoted to a description and discussion of the labial-velar stop of Ibibio. In the final section of the chapter, the information gained for Ibibio is used as the basis for a comparative examination of the consonantal phonetics of the other languages of the group.

Also necessary to an investigation of sound change is to establish the validity of the sound changes posited. In this case, since no prior diachronic work has been done on the Lower Cross languages, it has been necessary to reconstruct the consonant system of their latest common ancestor, Proto-Lower Cross. This reconstruction is presented in Chapter Four.

The information presented in Chapters Three and Four is then brought to bear, in Chapter Five, on a number of issues relevant to the role of phonetics in understanding sound change. In particular, it is shown how knowledge of the phonetic facts of the languages in question can lead to a deeper understanding of the changes that have occurred in the consonant systems of these languages. Possible



implications for a theory of sound change, especially insights into the relative importance of productive and perceptual factors are also discussed. In addition, it is argued that a detailed description of the phonetics of the daughter languages, together with an understanding of phonetic aspects of sound change, can lead to more a creditable and phonetically plausible reconstruction of the parent language.

The final chapter, Chapter Six, draws together the conclusions and accomplishments of the dissertation, as well as pointing to areas of interest for future research.

The dissertation, therefore, has a tripartite focus: the phonetic investigation of sound change is in some respects the main focus, but the phonetic description of the languages under study and the reconstruction of the consonant system of the parent language are also seen as necessary to accomplish the primary goal. Moreover, each of these can be viewed as constituting areas of interest in their own right. The underlying assumption of the dissertation is that an understanding of phonetic phenomena can lead to a greater understanding of sound change, and therefore also be able to make a significant contribution both to a general theory of sound change, and to the field of historical reconstruction. In the same vein, but more generally, phonetics can provide valuable information concerning apparent universal tendencies in phonology (cf. Ohala 1983, 1990b, and elsewhere); in this regard sound change is a fruitful area for research. Before moving on to the body of the dissertation, the rest of this Introduction presents a general background to the Lower Cross languages.

## **0.2. The Lower Cross Languages**

### **0.2.1. Geographical considerations**

The Lower Cross language group takes its name from its geographical location, being situated in the lower part of the Cross River basin of South-Eastern Nigeria<sup>1</sup>. Languages of the group are found in three contiguous Nigerian states in this coastal region: Rivers, Akwa Ibom, and Cross River, as well as across the international frontier to the Isangele sub-division of south-western Cameroun. Figure 0.2a shows the location of the Lower Cross group in West Africa.

In general, individual language names used in this work are those used by the speakers of a language for themselves and their language. ‘Oron’ and ‘Isangele’, for

---

<sup>1</sup> To the best of my knowledge, the term ‘Lower Cross’, as a name for the group, was coined by Cook (1969c).

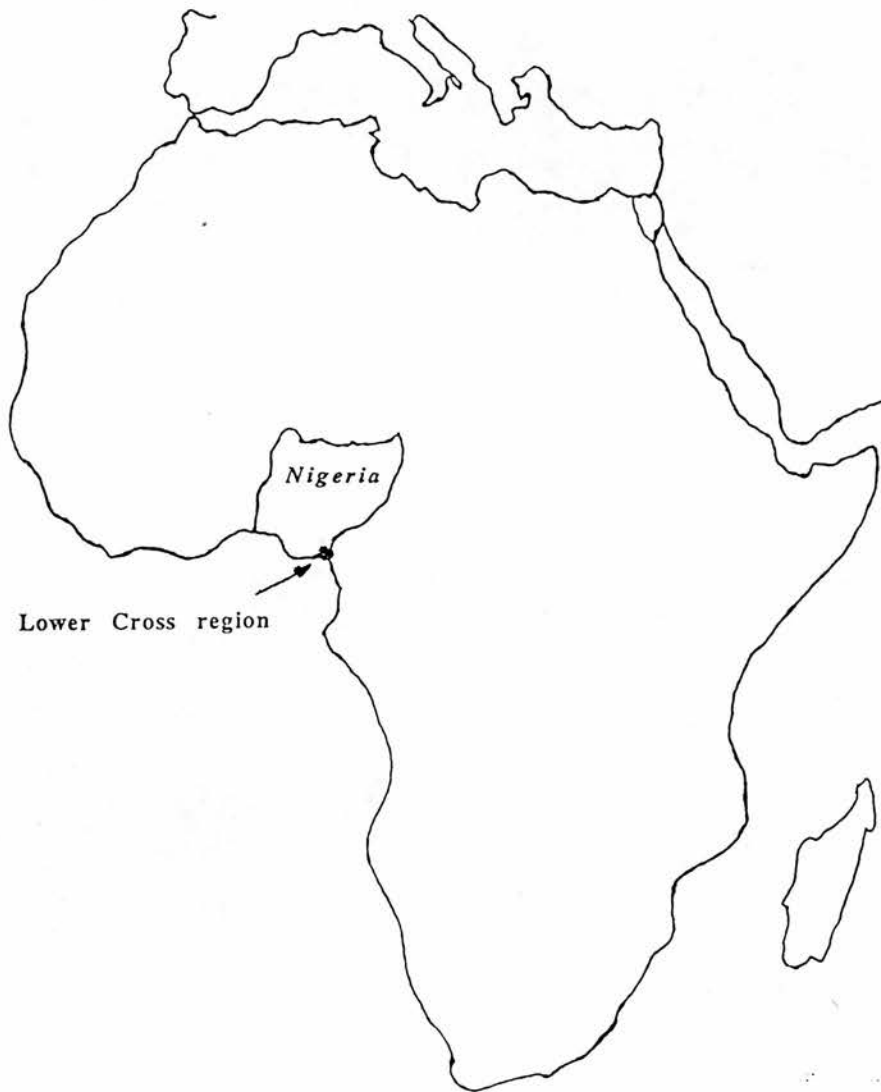


Figure 0.2a: Map Of Africa with the Lower Cross-speaking area shaded.



example, which are often used (by others) as language names, are here used only to describe geographical locations. That is, the Oro people speak Oro, but live in Oron; the Usakade speak Usakade, but will be referred to as living in Isangele. The Obolo and their language are commonly referred to as 'Andoni' by other Lower Cross groups. In the following list, language names are given in alphabetical order, with the place or alternate name following in parentheses, together with the State(s) which is the language's main location. In some cases the place name may differ only in spelling, as the language names are given in a more or less phonemic rendition.

Anaang	(Annang - Akwa Ibom)
Ebughu	(Akwa Ibom)
Efai	(Efiat - Akwa Ibom, Isangele)
Efik	(Cross River, Akwa Ibom)
Ekit	(Eket - Akwa Ibom)
Enwang	(Akwa Ibom)
Etebi	(Akwa Ibom)
Ibibio	(Akwa Ibom, Cross River)
Ibino	(Ibeno, Ibuno - Akwa Ibom) <sup>2</sup>
Ibuoro	(Iwerre - Akwa Ibom)
Iko	(Eastern Andoni - Akwa Ibom)
Ilue	(Idua - Akwa Ibom)
ItuMbuso	(Itu Mbon Uso - Akwa Ibom)
Obolo	(Andoni - Rivers, Akwa Ibom)
Okobo	(Akwa Ibom)
Oro	(Oron - Akwa Ibom)
Uda	(Akwa Ibom)
Ukwa	(Cross River)
Usakade	(Isangele, Cameroun)

These, then, are the languages included in the present study. Figure 0.2b gives the major locations for each language, though isolated pockets of some, not marked on the map, are also to be found. There are, for instance, Efik and Ibibio speakers in Isangele division, Anaang speakers in Imo State, and an Obolo settlement (Ido) further

---

<sup>2</sup> An Ibino colony has been established in Cameroun. This is relatively near to, but not contiguous with, the Lower Cross region. It is not clear to me how old this settlement is, but I have been told its inhabitants have maintained their language.

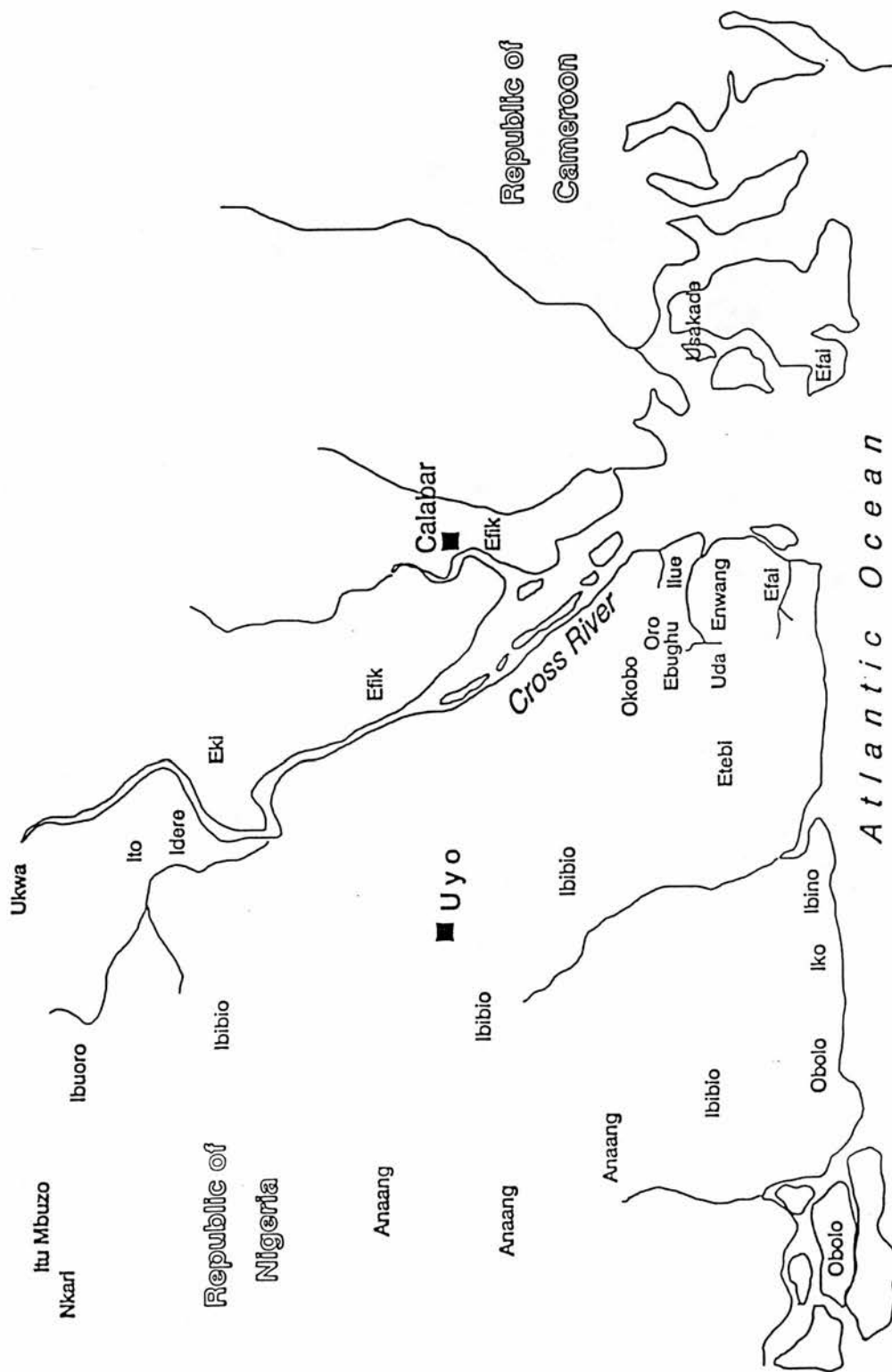


Figure 0.2b: Map of the Lower Cross-speaking area showing language distribution.

to the west in Rivers State, separate from the primary Obolo area. The existence of other Lower Cross languages not included in the present study is acknowledged. Data for Nkari have recently been collected, but not early enough to be included in the present study. Also Eki, Idere, and Ito are said to be distinct Lower Cross varieties, but to date no data have been collected for these, and it is not clear how or to what extent these differ from other Lower Cross languages, particularly Efik and Ibibio. Along with Nkari, these are included on the map in Fig. 0.2b.

#### 0.2.2. Demographic considerations

Efik is the best known language of the group, the Efik people having been the first in the area with whom the European missionaries and traders developed strong contacts. As a result, Efik was given an orthography in the middle years of the 19th century, and consequently became the dominant language of the region, having been used for trade, missionary, and educational purposes well outside the Efik speaking area itself, and indeed outside the Lower Cross region. Its status as *lingua franca* in the area has waned in recent years, due to a number of factors. Prime among these has been the increase in use of English, as education becomes more widespread, and also the phenomenal growth of Nigerian Pidgin (often referred to locally as 'Broken'). But also of considerable importance within the region is the growing pride of other groups in their own languages. However, one important result of the status Efik has enjoyed over the years is that it has become one of Africa's most studied languages<sup>3</sup>. Despite its prestige, Efik is by no means the largest of the group, being spoken by probably less than 500,000 people as a first language (i.e., as a mother tongue)<sup>4</sup>. Variation within the Efik area allows the delimitation of at least two dialects, that of Calabar, and that of the Enyong (Northern) region (cf. Cook 1985), with the Akpabuyo region to the east of Calabar perhaps constituting a third.

Ibibio is unquestionably the largest language of the group; with possibly as many as 3.5 million speakers, it ranks as the fourth largest of Nigeria's more than 400 languages, behind Hausa, Yoruba, and Igbo. The Ibibio language is currently undergoing a renaissance, having recently gained its own orthography (Essien 1983, 1984a, 1984b), and with steps being taken to improve and increase its use in education.

---

<sup>3</sup> At least perhaps until recently. Efik has somehow escaped the notice of the increasing number of generative linguists who are becoming interested in African languages, but see the work of T.L. Cook, and especially Cook (1985).

<sup>4</sup> All population figures given are to be considered estimates. While these are mostly extrapolated from official statistics, past censuses in Nigeria have generally been deemed unreliable. In any case, it has been several years since the last census was taken, and during the intervening period the country has been experiencing one of the highest birth rates in the world.

Within Ibibio there is considerable dialect variation, with dialects correlating approximately to clan groupings.

The Anaang constitute the next largest group, having about 1 million speakers and three major dialects, which will be referred to in this work by their geographical locations - Ikot Ekpene, Abak, and Ukanafun. Following this, the number of speakers for the various languages decreases significantly. Oro has approximately 400,000 speakers, Ekit 200,000 (and two dialects) Obolo 100,000 (and three main dialects; Faraclas 1984a), Okobo 50,000 speakers (two dialects), Enwang 15,000, Ebughu 15,000, Ilue possibly 10,000, and Usakade approximately 10,000 speakers. Population estimates are not available for Ibino, ItuMbuso, Efai, Ibuoro, Ukwa, Iko, and Uda, but in no case is it likely that any of them number more than 10,000. Iko, found in just three villages, is probably not spoken by more than 5,000 people.

### 0.2.3. Language and Dialect

The question of distinguishing language from dialect is a difficult one at the best of times, and the Lower Cross group is no exception to this problem. Indeed, a serious examination of this issue with regard to the Lower Cross situation would certainly provide a substantial contribution to the controversy. However, since this question is not the focus of the present work, a brief outline only of the Lower Cross situation is offered.

Following the criteria of Hansford *et al* (1976), languages such as Anaang, Efik, Ibibio, and Ukwa could arguably be considered to constitute a dialect cluster, while the entire group (excluding perhaps only Obolo) could be considered to be comprised of possibly three language clusters. The main criterion employed by Hansford *et al* for establishing these divisions is the use of cognacy rates. These are established through making a pairwise comparison of basic vocabulary lists (i.e., Swadesh-type lists) of all the languages of a group, which allows for the determination of the percentage of words any pair of languages within the group shares as cognates. A cognacy rate of 80% or greater is considered sufficient to regard the languages concerned as forming a dialect cluster, while rates of between 70% and 80% lead to considering the languages in question as being a language cluster. Also taken into consideration is the degree of mutual intelligibility, which is assumed by Hansford and his colleagues to be correlated to the cognacy rate. These classifications are intended to reflect a certain degree of (genetic) linguistic affinity; there are, however, a great many problems associated with this technique, such as those involved in actually deciding

whether or not two lexical items should be considered cognate, or what constitutes mutual intelligibility. These problems have lead me to conclude that as a technique for classifying languages into dialects or languages, it is at best arbitrary.

Equally important to the question of language or dialect (indeed perhaps more so) are social, cultural, and political considerations. In many instances, the actual deciding factor as to whether certain languages should be classified as dialects or languages depends on political boundaries or the cultural identities of the groups involved. With regard to the present study, through taking these considerations into account, and in order to maintain a certain neutrality on these issues, the nineteen languages listed above are referred to here as languages rather than dialects, irrespective of cognacy rates, degree of mutual intelligibility, or other quasi-linguistic criteria that may be invoked to distinguish language from dialect<sup>5</sup>. In addition, it will be remembered that despite arguments which may exist for calling Anaang, Efik, Ibibio, and Ukwa together a dialect cluster, each of these (except perhaps Ukwa) has clearly discernible dialects of its own. In any event, there is no need, for the present purposes, i.e., the phonetic investigation of sound change, to make a distinction between language and dialect.

#### 0.2.4. Linguistic interaction in the Lower Cross region.

As might be surmised from the number of languages found in such a relatively small and densely populated area, the linguistic situation in the Lower Cross region is complex. Most people (except perhaps the very young) are multilingual, speaking their own native language, and to varying degrees of fluency, either or both of English and Nigeria Pidgin. (Though in the Lower Cross speaking area, Pidgin is primarily an urban phenomenon.) Most also speak, or at least understand, one or more of the other local (i.e., Lower Cross) languages, and some have a degree of fluency in either or both of Igbo and Yoruba.

Where mutual intelligibility exists across Lower Cross languages, for instance as among Anaang, Efik, Ibibio, and perhaps Ukwa, the normal situation is for each speaker to use his or her own language and rely on the other to understand. Among these four, mutual intelligibility is fairly high (the more remote varieties of Anaang being exceptional). For the others which are classified below as Central Lower Cross (see Fig. 0.2c), unidirectional intelligibility generally exists; that is, speakers of Ekit,

---

<sup>5</sup> An alternative might be to adopt the term 'lect', which is becoming increasingly popular for this purpose; however similar problems arise when considering the status of a 'lect', although it does perhaps enjoy a certain neutrality.



Etebi, Ibuoro, and ItuMbuso generally claim no trouble understanding Efik or Ibibio (though to a lesser extent Anaang), while most speakers of the latter three would not ordinarily claim to understand any of the former. However, both Ekit and Etebi are mutually intelligible, as are, to a lesser extent, Ibuoro and ItuMbuso. Between these two pairs, though, there is no suggestion of mutual or even unidirectional intelligibility.

Among the rest, speakers of most would claim an understanding at least of Efik or Ibibio, though this could well be due to learning, and the dominance of Efik and Ibibio, rather than immediate linguistic similarities. Enwang and Uda, however, are mutually intelligible, and most speakers of Ebughu, Efai, Enwang, Ilue, Okobo and Uda have some understanding of Oro, as it is the dominant language of the Oron sub-region of the Lower Cross area. The Usakade generally understand and can speak Efik, and can understand Ibibio, though the reverse is not true.

Within dialects of Obolo there is mutual intelligibility, though not between Obolo and any other Lower Cross language. As the Obolo mainly interact with their non-Lower Cross neighbours to the west (Ijo, Ogoni, etc.) they are sufficiently removed from the rest of the group that it is relatively rare to find Obolo speakers who understand Efik or Ibibio. Due to its geographical proximity, Iko is often assumed to be a dialect of Obolo, and certain oral traditions claim that the Ibino originate in Obolo. (See Connell and Maison, forthcoming for more on Lower Cross oral tradition.) There appear to be no linguistic characteristics common to these three, however, that cannot be attributed either to their common Lower Cross heritage or borrowing; certainly there is no question of mutual intelligibility between Obolo and either of the other two. It is quite probable that a fair degree of intelligibility exists between Iko and Ibino, but this has yet to be affirmed.

#### 0.2.5. Genetic Affiliations

The Lower Cross languages (i.e., those that were then known or identified as such) were classified by Greenberg (1963) as Cross River 2, together with languages such as Kana and Korop, which have since been reclassified into different groups. Modifications to Greenberg's classification have resulted in the establishment of Lower Cross as a distinct subgroup of the Delta Cross branch of Cross River. Cross River itself is a branch of (New) Benue-Congo, with this in turn being a major branch of the Niger-Congo family (Williamson 1989). Figure 0.2c gives a genetic tree showing the affiliation of the Lower Cross languages within Niger-Congo.

Within Delta Cross there are four subgroups, Central Delta, Ogoni, Lower Cross and Upper Cross; although detailed comparative work has yet to be done among the four, it would appear the closest affiliation is between Upper and Lower Cross, while the Central Delta languages appear to be most distant. The most recent published classification of the Cross River languages is Faraclas (1989).

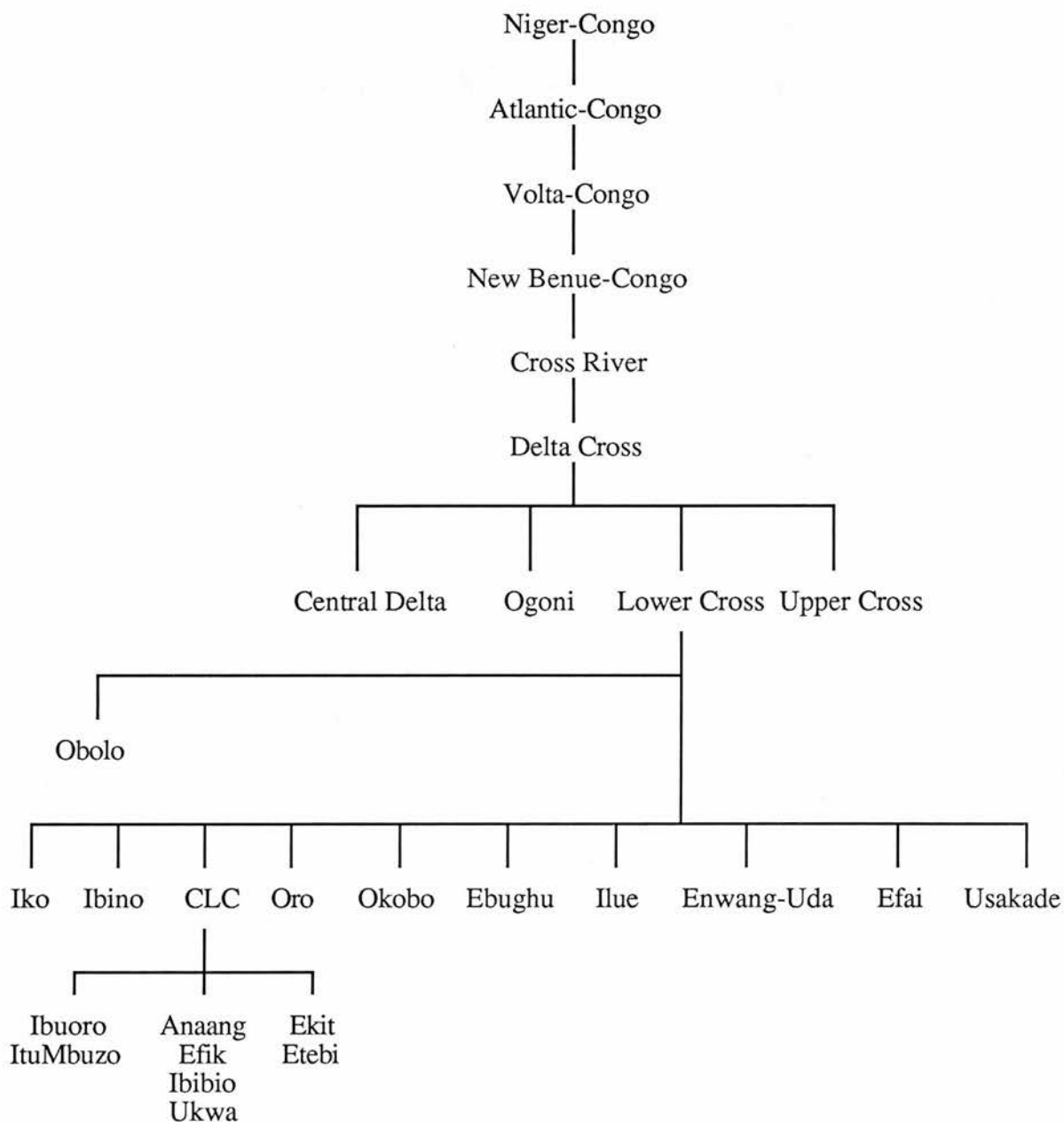


Figure 0.2c: Genetic tree showing relationships of Lower Cross languages.

Although there is little to dispute regarding the cohesion of the Lower Cross group *vis à vis* other linguistic groups in the area there is, as will become apparent in this work, some reason to question the status of Obolo within Lower Cross. It is, however, accepted here as a part of the group, as it is closer to Lower Cross than to any of the other Delta Cross groups. To dissociate Obolo from Lower Cross would, in the end, have little effect on the classification as it stands - 'Lower Cross' would move down a node on the tree, and a new term would be needed to replace 'Lower Cross' at its present node

There has been some disagreement regarding the subclassification of LC languages. The divisions presented in Fig. 0.2c, and the establishment of Central Lower Cross as a subgroup differ from earlier subclassifications (e.g., as presented in Cook 1985: 1-2). The subgrouping presented here is based mainly on evidence of sound correspondences (see Chapter Four), but has to some extent been informed by a lexicostatistic analysis (not included for discussion here, but see Connell 1990). Further discussion of this classification, and its implications for Lower Cross prehistory are presented in Connell and Maison (forthcoming).

#### 0.2.6. Previous Studies

Taken as a whole, rather little work has been done on the Lower Cross languages; i.e., their characteristics as a group are but little known. Despite this, Efik, as pointed out previously, is one of Africa's most studied languages, having been examined in some depth by such scholars as the Rev. Hugh Goldie (*Principles of Efik Grammar*, 1857; *Dictionary of the Efik Language*, 1862), Ida Ward (*The Phonetic and Tonal Structure of Efik*, 1933), W. Welmers (*Efik*, 1966 - a language course - among other works), F.D.D. Winston, (1960, 1970), and most recently the work of T.L. Cook (see references). Through the work of these linguists, Efik studies have had a significant though little recognized impact on both African linguistics and linguistic theory in general (cf. Cook 1985: 4). Winston (1960), for example, gives the first rigorous analysis of a tone language using the notion of downstep, a concept which has since become integral to Generative treatments of both tone and intonation.

Interest in other Lower Cross languages has not been as quick to develop, perhaps due in large part to the influential status enjoyed by Efik. As a result, it has often been assumed that Efik is representative of the entire group, an assumption which



is in fact unfounded (cf. Connell 1987a)<sup>6</sup>. In recent years, work on Lower Cross languages has begun to increase, with a number of primarily descriptive articles on Ibibio having been published by O.E. Essien (and a grammar, Essien 1990, recently published), as well as an Ibibio dictionary (Kaufmann 1985), and several unpublished PhD. dissertations (Kaufmann 1968, Boys 1979, Ekere 1987, M. Essien 1989, and Urua 1990). Obolo has been studied primarily by Faraclas, with the most significant work being a descriptive grammar (Faraclas 1984a; also of note are Faraclas 1982, and 1984b, and Faraclas and Williamson 1984). Kuperus' (1978) work on Oro is also noteworthy, though unpublished. Comparative work on the group has lagged behind until recently, with Connell (1984, 1985, 1987a, 1987b, 1990) and an unpublished manuscript by Faraclas (Faraclas n.d.) being the only efforts to date. Finally worth mention here is the work of D.C. Simmons (1956, 1957, 1965, n.d.). Though much of Simmons' work on Lower Cross is from an anthropological perspective, his linguistic studies are of some descriptive interest. The works mentioned here are by no means an exhaustive list of research on Lower Cross languages, simply mention of what may be considered the most important.

### 0.3. Informants and Data

The data used in this study were collected mainly over a period of three years, while I was employed as a lecturer in the Dept. of Languages and Linguistics at the University of Calabar in Nigeria. Additional material was subsequently collected during a field trip conducted in September and October, 1988. Visits were made on numerous occasions to a variety of locations in the Lower Cross speaking area. Data for all languages were collected by myself (but see Acknowledgements), with the exception of Iko. In this case, material was recorded for me by Prof. Kay Williamson in Port Harcourt. In addition to material collected in the Lower Cross area itself, two native speakers of Ibibio resident in Edinburgh kindly agreed to act as subject for instrumental investigations. More detail on this is presented in Chapter Three.

The basic (minimal) set of data consists of a Swadesh-type wordlist (the Ibadan 400 wordlist<sup>7</sup>, modified, and expanded to over 560 words). A list of some 120 sentences (that used in preparing the *Atlas Linguistique de Cameroun*, though also somewhat modified), was collected for some languages, though in certain cases only a

---

<sup>6</sup> Though Jenewari (1983) apparently takes Obolo to be representative of Lower Cross, an assumption that is even farther from the mark.

<sup>7</sup> The Ibadan list is an expansion of the original Swadesh 100 and 200-word lists. It was developed at the University of Ibadan in Nigeria in the late 1960s, and includes not only non-cultural items, but also a number of items that would be considered specific to the West African context.

subset of this list was collected. The most extensive data collection has been done for Ibibio, for which the above mentioned lists have been collected for a variety of dialects, and from a number of speakers, as well as substantial other data. All word and sentence lists were collected on tape, initially transcribed from the recordings and then for the most part cross-checked with the informant. For certain of the smaller (and more remote) languages - especially Ebughu, Efai, Enwang, Ilue, Uda, and Ukwá - detailed cross-checking was not possible due to time constraints, as these are the ones investigated during the 1988 field trip. All transcriptions from tape have been checked a number of times, with intervening periods of several months between each transcription. The wordlists are included in Appendix A.

Many of the informants were of university student age (i.e., 18 - 24 years) and spoke English fluently, so the problem of interpretation did not arise. In other cases, especially when interviewing older people in more remote villages, an interpreter was needed (my oldest informant was said to be 99). Most of the informants had some competence in more than one Lower Cross language, typically an understanding of Efik and/or Ibibio, though possibly others, as well as reasonable fluency in English and Nigerian Pidgin. When interpretation was needed this was normally done with an intermediary using the language of the informant and English. On one occasion, with 99 year old Chief Okon Ekpong Inyang of Idua Asang, Efik was used as the intermediate language, and in most instances, informants were able to freely draw comparisons to other Lower Cross languages, which ensured that misunderstandings were kept to an absolute minimum.

## Chapter One

### Phonetics and Sound Change

#### 1.1. What constitutes sound change

Any work on sound change must make explicit from the outset exactly which aspects of this multifaceted phenomenon are to be treated. The literature on sound change is wide-ranging, and even a cursory glance will reveal the term ‘sound change’ to have been used in various ways by different authors. These differences in usage reflect divergent approaches and understanding of what sound change is, but can essentially be seen as attempts to examine one or more of three different aspects of what is truly a complex phenomenon: the phonetic, phonological, and sociolinguistic. Certain authors might deny the relevance of one or another of these aspects, but for a complete understanding of this side of language behavior, all three must be examined, and the results of each study understood in context of the others. In the present work, I focus on phonetic aspects of consonantal change in the Lower Cross languages; some reference is made to both phonological and sociolinguistic considerations, but a detailed treatment of these is considered to be outside the scope of the dissertation<sup>8</sup>. I begin with a discussion of how various researchers have viewed the phenomenon of sound change and then, in the body of this chapter, attempt to situate the phonetic study of sound change within a coherent theoretical framework.

---

<sup>8</sup> This is not to suggest there is a clear boundary between each of these three aspects; it is, at least in part, the difficulty in delimiting the three areas with regard to sound change that has led to confusion in use of the term itself.

### 1.1.1. Sound change as a phonetic process

In the modern era, serious investigation of sound change can be said to have begun with the Neogrammarians. For them, their students, and immediate successors, sound change was primarily a phonetic event - only those modifications in a sound system which were phonetically motivated and regular (in their technical sense of the term 'regular'<sup>9</sup>) were considered to be 'sound changes'. Other modifications, which appeared to be the result of analogy, or other such non-regular mechanisms were not, in their view, instances of sound change, but rather, were called "sound substitutions" (Paul 1888: 58). Anderson (1985: 40) characterizes the approach of this period as follows:

a prevalent attitude at the time [which arose] from a fusion of Neogrammarian studies on the regularity of sound change with the increasing observational sophistication of late 19th century phoneticians [was that] a sufficiently minute study of (synchronic) phonetic detail would furnish comprehensive explanations for sound change.

Given this prevailing attitude, Saussure's use of the term 'phonetics', "phonetics - and all of phonetics - is the prime object of diachronic linguistics" (Saussure 1974: 140), to refer only to the diachronic side of the study of sound systems, is understandable if somewhat odd from today's perspective. In addition to being diachronic in nature, phonetic study was, for Saussure, "based on the mechanisms by which speakers realize the sounds of their language in concrete acts of speaking" (Anderson, 1985: 37). In Saussure's view, then, sound change was a phenomenon entirely encompassed in 'parole' (cf. Saussure 1974: 18).

All this supports the view that sound change was seen as a phonetic, mechanical event; still, it<sup>is</sup> not often recognized that this was not, in fact, the whole story for the Neogrammarians, who also claimed that, "there must also be a science which undertakes extensive observation of the operation of the psychological factors which are at work in countless sound changes" (Osthoff and Brugmann, 1967: 198).

---

<sup>9</sup> "Every sound change, inasmuch as it occurs mechanically, takes place according to laws that admit no exception". (Osthoff & Brugmann, from 'The Preface to Morphological Investigations in the Sphere of the Indo-European Languages', 1878; translated in Lehmann 1967: 204). The term by which this claim is known today, the 'regularity hypothesis' actually came much later, possibly from Hockett (1958).

### 1.1.2. Sound change as a phonological phenomenon

Throughout most of the middle years of this century, interest focussed more on sound change as a phonological phenomenon (or, on phonological aspects of sound change), though from various theoretical perspectives. Representative of these are the Prague views of Martinet, the structuralist position of Hoenigswald, and the Generativists (e.g., King, Postal, and Kiparsky), with their predilection for seeing sound change in terms of the manipulation of phonological rules, and the process oriented approach of Stampe's *Natural Phonology*.

Martinet's approach to sound change (e.g., Martinet 1955), in tune with Prague School phonology, was functionalist but, while primarily phonological, did not ignore phonetic considerations. Two basic types of change were recognized, conditioned and unconditioned, and these were seen as having different functions in a phonological system. Conditioned change is accounted for more from a phonetic perspective, by the 'principle of least effort', with its function being to modify articulation so that it is simpler (i.e., 'ease of articulation', a view carried over from the Neogrammarians; more on this below, in §1.7). Unconditioned change results from pressures internal to the system; the assumed tendency of phonological systems to move toward greater symmetry and "sufficient perceptual separation" (cf. Ladefoged 1982, and also much of B. Lindblom's work, for related views), or the notion of 'functional load' of phonological oppositions being two such kinds of pressure.

Hoenigswald (1960) took the view that sound change was best regarded as a phonological phenomenon, and he specifically downplayed the phonetic aspects, claiming that, "mere alternation in the physical properties of phones does not constitute sound change in the technical sense except minimally" (p. 72). For him, "the term is used when the later (i.e., replacing) morphs are in some way phonemically different from the earlier (replaced) ones" (p. 72). The process of sound change, then, is "fundamentally that of borrowing with sound substitution" (p. 54). As we see below (§1.6, on gradualness), Hoenigswald is not entirely consistent in his use of the term, as he does admit to phonetic factors being involved, though he apparently prefers to minimize their importance.

For researchers following a generative line of thinking (e.g., see Kiparsky 1968, King 1969 for the classical Generative statement; Kiparsky 1988 gives an update) the cause of sound change was apparently relatively easy to find. All that was necessary was to posit some sort of restructuring of the phonological rules, i.e., the



addition, loss, or reordering of rules. This approach has been appropriately criticized (e.g., Ohala 1974b, Pagliuca and Mowrey 1987) in that, while rules may adequately express a diachronic *correspondence*, they go nowhere in furthering our understanding of sound *change*; e.g., the question of what precipitates a phonological restructuring has never been adequately addressed in this approach.

Also in a psychological vein, Stampe's (1969, 1979) Natural Phonology gained a certain amount of currency. This theory attempted to explain phenomena in child language by seeing the acquisition of phonology as a process whereby the child gradually approximates adult phonology through the suppression or limitation of natural phonological processes, such as devoicing of obstruents or flap deletion. Stampe (1979) and others have attempted to account for sound change by extending the theory of Natural Phonology into the realm of sound change. It was suggested that sound change occurred when a given process normally suppressed ceased to be so or, conversely, a process not ordinarily suppressed became so.

Among the weaknesses in applying this theory to sound change was the assumption that diachronic events mirror acquisitional events. Admittedly a certain degree of correspondence exists between the two; that is, certain sound changes do seem to be reflected in the child's phonological development, and sound change often does appear to be 'transgenerational'. However, that (some) sound change may be transgenerational does not necessarily imply a relation to acquisition. Moreover, there also seems to be a considerable amount of divergence between acquisitional phenomena and diachronic events - i.e., there are numerous instances of sound change which do not seem to turn up as acquisition processes, and similarly a great many acquisition processes which apparently have never been manifested as diachronic changes (cf. Drachman 1978). These concerns aside, Natural Phonology has also come under essentially the same criticism as Generative Phonology; i.e., questions as to what kinds of conditions must obtain before a process that has been consistently suppressed suddenly or gradually ceases to be suppressed, remain unanswered (cf. Jeffers and Lehiste 1979: 101-102).

For Catford (1974), what may be called a rule-oriented or psychological approach is putting the cart before the horse. That is, he suggests, it would seem more reasonable that a change in phonological rules follows the spread and generalization of an innovation in a speech community, and that it would be a "gross obscurantist error to believe that the rule change occurred first" (p. 22). We might well ask by what

mystical means does the same restructuring occur (whether 'restructuring' refers to rules or suppression of processes) independently in the multitude of individuals who comprise a speech community? Assuming there is no kind of phonological clock which activates a change in the phonological component of an individual's grammar, and for all members of a speech community at approximately the same time, it seems we must look elsewhere for the motivations of sound change. This is particularly true if, as Ohala has often pointed out (e.g., 1971, 1974a, 1974b, 1978, 1983, 1989), we are to account for similar innovations occurring in a huge and disparate variety of languages from around the world.

### 1.1.3. Sociolinguistic investigation of sound change

In the last twenty years or so, interest has moved more toward a sociolinguistic approach to the examination of sound change. This has been a bi-directional effort, represented on one hand by the work of Labov and his colleagues (e.g., Labov 1972, 1981, and Weinreich, Labov, and Herzog, 1968), and on the other by the work of Wang and Chen (e.g., Wang 1969, Chen and Wang 1975). Labov's interest has primarily been in examining synchronic variation according to social factors (e.g., age, class, gender), which for many is now viewed as 'sound change in progress', while that of Wang and Chen, in developing the theory of lexical diffusion<sup>10</sup>, has been more strictly diachronic in orientation. Taken together, the work of these scholars has done much to clarify the mechanisms by which a sound change may spread through a speech community. Coates (1988) and Kiparsky (1988) provide useful surveys and discussion of recent developments on this side of historical linguistics.

We see here, then, the three different uses of the term 'sound change': to refer to a phonetic process, a phonological phenomenon, and a sociolinguistic process. The different usages are, in part, a result of different theoretical approaches and interests, arising at different times. At the present time, many scholars are ambiguous in their use of the term<sup>11</sup>, using it interchangeably to refer to each of these three aspects of sound change though, as will be seen, there is a growing tendency to greater precision.

---

<sup>10</sup> Though it may be questioned whether lexical diffusion is a result of sociolinguistic factors (J. Hajek personal communication), it does seem to be reasonable to assume that for the most part, the gradual spread of a change through a speaker's lexicon, or through a speech community, would be governed by social factors.

<sup>11</sup> Ohala in much of his writing, for example, appears to use the term for both the phonetic process and the more general, or completed phonological development. In general, researchers who refer to 'sound change in progress' as a sociolinguistic phenomenon, while still recognizing a phonetic aspect to change, can be said to demonstrate this ambivalence. (But note, even in these paragraphs the ambiguity has not been entirely avoided).

#### 1.1.4. Distinguishing different aspects of sound change

Parallel to the sociolinguistic interest in sound change, there has been renewed interest in its phonetic aspects, in discovering the extent to which phonetics is important in examining and understanding sound change. The distinction between the two areas (phonetics and sociolinguistics) was explicitly recognized by Chen and Wang (1975), while directing their efforts to lexical diffusion, and has also been emphasized by scholars such as Catford (1974), Javkin (1979) and Ohala (e.g., 1974a, 1974b).

For Catford (1974), there is a two-way distinction to be made in studying sound change: what he terms 'mutation' and 'substitution'. Mutation refers to "a process whereby one or more features of a given sound changes its value in the course of time" (p.21). Substitution, on the other hand, is "a process whereby the pronunciation of particular lexical or grammatical items of a language are changed as a consequence of the speakers of the language selecting one rather than another of two (or more) possible pronunciations..." (p.22). Change of this latter sort could be seen as having a sociolinguistic motivation. Other modifications, such as those due to analogical change, would also be considered to be substitutions, since they involve a choice among sounds already present in the language. Catford also makes clear a difference between mutation and substitution on one hand, and 'adoption' on the other. This latter involves the introduction of a new sound through borrowing from another language or dialect. Adoption, and at least some forms of substitution, have a sociolinguistic, rather than phonetic, motivation underlying them. Therefore, Catford arrives at a dichotomy between sound change on one hand, and sound substitution/adoption on the other - a distinction very similar to that expressed by Paul, and referred to above.

The distinction drawn by Catford is essentially that of Chen and Wang (1975), who use the terms 'actuation' and 'implementation' for mutation and substitution, respectively. It is also essentially that favoured by Ohala (e.g., 1974a) when he refers to the 'origin' and 'propagation' of a sound change, though what Catford refers to as adoption apparently is found on both sides of Ohala's dichotomy. Ohala's proposal is discussed in depth in the following section.

It would appear, therefore, that for these scholars, 'sound change' is a phonetic event. In accepting this, we can then find a way out of the terminological confusion. One might use the term 'mutation', in Catford's sense, and at the same time adopt his other terms. An alternative (cf. Milroy and Milroy 1985) would be to adopt the term



'innovation' for the phonetic process or event, and retain 'change' for the sociolinguistic process. However, as 'innovation' is already current in much writing, and often taken as synonymous with the ambiguous 'sound change', its use might simply add to the confusion. A preferable alternative is to maintain the term 'sound change' with a meaning akin to its original (Neogrammarian) one - to refer to a phonetic event or process. We may then refer to the spread or propagation of a sound change (or substitution) as being a sociolinguistic process, and the generalization and acceptance of a sound change as a phonological restructuring which occurs subsequent to the actual change. (Though it is not necessarily the case that all sound changes that have become generalized result in phonological restructuring.)

## 1.2. A Theoretical Framework for Investigating Sound Change.

Ohala (1974a) proposes a framework for investigating sound change, and it is this that is adopted as the basis of the present approach. 'Explaining' sound change is seen as involving two separate tasks: investigating the causes or origins of changes, and examining the mechanisms by which changes are spread and subsequently accepted by a speech community. As mentioned above, research on this latter aspect has seen much progress over the last two decades but, while of great interest, it is not the focus of the present work.

In studying the origins of sound change, a basic 'classification' is useful; for Ohala this is, first, to distinguish between those changes,

which are observed in numerous languages distant from one another typologically, chronologically, and geographically, [and which therefore] must have been caused by factors universally present in all speakers and all societies throughout time, namely the inherent constraints of the speech production and perception system. (p. 355-6),

and those which are "language specific and culture specific [such as] hypercorrection, spelling pronunciation, 'fashionable' pronunciation, ... etc..." (p. 356). Again, we see the distinction drawn by the Neogrammarians, as expressed by Paul (1888: 58); the division Ohala makes is precisely that between sound change and sound substitution. To be clear, we might also add to this that not all changes resulting from inherent constraints need to be common or widespread, as even those sounds which are geographically restricted are subject to these constraints.

The phrase, "inherent constraints of the speech production and perception system", refers to facts of articulation, to acoustic characteristics of speech, and to facts

of perception. It follows, then, that to understand and explain sound change, a full understanding of the phonetic facts of the language(s) in question is necessary. True enough, it is the phonetic characteristics of the parent language (which no longer exists) that would have given rise to the observed changes, and these characteristics are of course, unobservable. However, by examining the phonetic characteristics of the daughter languages in the light of what is known of phonetics generally, we may more accurately determine the forms and conditions that gave rise to the presently existing ones.

The model Ohala uses to examine sound change is borrowed from signal detection theory. An intended message, as conceived by the speaker, may be modified (perturbed) by physiological constraints at the speaker's end; the message may be further perturbed at the listener's end by the limitations of the auditory apparatus. In other words, noise (in the technical sense) may be introduced at a variety of points during the transmission, and this may cause the received message to differ from the intended one. The listener may then imitate what he or she heard, rather than what was intended. Ohala (and Javkin, see below) apparently place great importance on the role of the listener; this aspect is explored below (§1.8) in greater depth.

### 1.3. Javkin's Taxonomy

Javkin (1979) has taken a closer look at this model and found it appropriate to have a tripartite division: articulatory constraints, acoustic constraints, and auditory constraints. In this case, 'acoustic constraints' refers to noise that the speech signal may be subject to during transmission; 'auditory constraints' refers to the limitations of the auditory system itself. That is, Javkin sees the possibility of sound change arising at three different stages in the speech transmission process. By examining the kind of changes that may occur at each stage in the transmission process, and by determining the quality and quantity of noise that may occur at each stage, one can reach a satisfactory explanation for the change at hand.

This framework seems to be an appropriate starting point for the investigation of sound changes which, in Ohala's (1974a: 355-6) words, are "natural", or "physically-actuated". Javkin has taken the challenge of classifying sound change in a different direction from most others<sup>12</sup>, by doing this within the framework presented

---

<sup>12</sup> I am referring here to classifications such as that found in Anttila (1972) which view sound change according to the result, e.g., split, merger, etc.

above. Using the signal detection model, he has been able to classify change into four categories. This section examines his proposed taxonomy.

### 1.3.1. Type 1: Articulatory-based changes

In instances of this type of change, perturbation of the articulation of a given sound occurs. Javkin cites the well-known example of epenthetic stops between nasals and following fricatives to illustrate this type, (e.g., in certain accents of English, ‘something’ [sʌmθɪŋ] > [sʌmpθɪŋ]). What is said to be characteristic of this type of development is that there is no loss of perceptual distinction on the part of the listener. That is, both the speaker and the listener use the same articulation, but what was for the speaker unintentional (e.g., the epenthetic stop), becomes intentional for the listener. Even in these cases, which are clearly articulatory in nature, the perceptual mechanism is said to play a role, in that the perturbation must be sufficiently perceptible for the listener to hear and recreate his or her speech on the new model.

### 1.3.2. Type 2: Articulatory-based changes

The second category of change is, like the first, based in perturbations of the articulation of a given sound. It is argued, however that this differs from the first type in that in this second case, a distinction is lost by the perceptual system. Javkin offers two examples of this type of change. The first of these is the development of contrastive tone from an earlier voicing distinction (Matisoff 1973 provides an overview of this phenomenon) and the subsequent loss (usually) of the voicing distinction. The second example is the frequently observed case of vowel nasalization in the environment of nasal consonants, where a vowel assumes the nasality of the neighbouring consonant. The consonant is subsequently lost, leaving the nasality of the vowel to become distinctive. In both of these examples, it is argued that the listener uses a different articulation than the speaker, a result of the loss of distinction. It seems clear, though, that the change is the result of a perturbation in articulation.

### 1.3.3. Type 3: Acoustically-based changes

Again, in this third type of change, articulatory factors play a role, but a secondary one. The basis of these changes can be found in the many-to-one relationship that exists between articulatory configuration and acoustic result. Here the listener, on perceiving an acoustic shape, associates it with a different articulation than the one used by the speaker, and consequently uses this new one. The example used by Javkin is the instance of palatalized labials [pj] changing to [t] in certain dialects of Czech. Here it is argued that the change occurs because the spectral envelope of [pj]

shows greater similarity to [t] than to that of [p]; hence a perceptual confusion may result, followed by shift in articulation.

The crucial difference between types one and two on one hand and type three on the other, is that for the first two, the change is said to occur as a result of the perceptual mechanism detecting articulatory changes, whereas for type 3, the perceptual mechanism fails to distinguish between two articulations.

#### 1.3.4. Type 4: Auditory-based changes

Changes of this category are said to be induced by the limitations of the perceptual mechanism itself, rather than any kind of articulatory adjustment or acoustic similarity. To exemplify this type, Javkin discusses tone spreading, which is believed to occur most commonly in a left to right direction (Hyman 1975 claims this is a universal). For example, a High - Low sequence may become High - Falling. It is suggested that there is an inherent bias in the auditory system which allows for quicker or earlier processing of spectral contours as opposed to pitch contours. A tone originally aligned with one vowel may then become realigned with the subsequent one.

A second example of this type deals with vowel lengthening. The claim is made that vowels are universally longer before voiced consonants, which is said to be the result of an original perceptual bias prompting speakers to actually make vowels longer. This may subsequently lead to a length contrast in vowels, replacing the earlier voicing contrast in consonants.

#### 1.3.5. Discussion of Javkin's taxonomy

The fundamental dichotomy in Javkin's taxonomy is between sound changes which somehow involve the mechanics of speech production and their consequences (i.e., articulatory configurations and their resultant acoustic structures), and those which primarily involve the auditory system. Among those of the first category, we see again a bipartite division; those changes (Types 1 and 2) which are called articulatory, and those which are said to be acoustically based (Type 3). As pointed out by Javkin, all of these involve both the articulatory and perceptual mechanisms, though with varying degrees of importance for each in the different types. The basis for distinguishing between articulatory and acoustic types, as outlined above, seems fair; there appears, however, to be reason to examine more closely the distinction between the two articulatory types.

In Type 1, the example of epenthetic stops between nasals and fricatives was described as having both the speaker and the listener using the same articulation, with no loss of distinction. The result was an unintended articulation being reinterpreted as intentional. In Type 2, it is claimed that the speaker and listener use different articulations as a result of a lost perceptual distinction. However, for the example of vowel nasalization, it is admitted by Javkin that nasalization is, "...a result of an articulatory effect... causing a perturbation (nasalization of the vowel) which is interpreted by listeners as intended and part of the linguistic code" (1979: 7). It could also be said, in the tonogenesis example, that the F0 perturbation caused by the neighbouring obstruent is reinterpreted as intentional. At this stage, then, one could not argue that there is a difference between Type 1 and Type 2. The difference seems to come in when the perturbation, originally unintended, becomes phonologized - either prior or subsequent to (or possibly concurrent with) the loss of the articulatory feature that was once phonologically contrastive. The loss of this feature, be it a nasal consonant or a voicing distinction as in these examples, or whatever, must be regarded as a separate, even if not entirely independent, development. The phonologization itself is a separate, non-phonetic process and should not be used criterially in a phonetically based taxonomy of sound change.

Looking at Type 4 change, one could raise questions about its operation, at least with regard to the the examples offered. In the case of tone spreading, there are many details to this phenomenon which appear to be problematic. One could ask, for example, why this perceptual bias should be limited to two syllables - why, that is, does the Low of the High - Low sequence not spread to the next syllable, instead of the two tones becoming aligned with the one syllable? Or, why do certain consonants seem to permit tone spreading more than others? (That is, there are production factors to be considered, as well.) On the other hand, there does seem to be sufficient reason to accept that the auditory system does process pitch phenomena separately from spectral phenomena (see, for example, Repp and Lin 1990 and references cited there). There are problems as well with the vowel lengthening example, one being that it is in fact not universal that vowels are longer before voiced consonants, although there may be a tendency in this direction. More important though, is that it is by no means clear how one would set about testing what amounts to a 'chicken before the egg' hypothesis regarding the postulated relation between vowel length and voicing of consonants. It is reasonable to suggest that the tendency for vowels to be longer before voiced consonants is related to the tendency for voiced consonants to be shorter than voiceless ones - a 'balancing act' which has to do with the temporal and rhythmic structure of a



language, and that attempts to account for the development of distinctive vowel length should be approached from this perspective.

These criticisms apart, however, there remain other ways in which sound change can be mediated during the perceptual process. The phenomena referred to by Ohala (1989) as 'hypocorrection' and 'hypercorrection' come under this rubric, and these are discussed below, in §1.8, when the role of the listener is examined in greater depth.

#### 1.3.6. Summary

Javkin's taxonomy can be reduced to three basic types of sound change: articulatory, acoustic, and auditory. This classification is neater than his original one, in that these three categories now parallel the three stages of the signal detection model he suggests for speech transmission. In addition, the distinctions between the three can now be based on phonetic facts, rather than being confounded by phonological concerns. This is important in that the mechanics of sound change are of interest, whether or not the change, in the end, becomes phonologized.

### 1.4. Catford's Taxonomy

Javkin's is not the only taxonomy of sound change which can be said to be based on facts of speech production and perception, although it may be the most explicit. Catford (1974), too, has discussed sound change (both 'mutations' and other types) from this point of view. Although he uses the same model of speech transmission (at least implicitly) as Javkin, he arrives at a slightly different categorization, involving five types of change. These are said to correspond to what he sees as five different phases in the speech transmission process.

The first of these is the "central programming phase". The kinds of change Catford sees associated with this phase are some slips of the tongue, such as metatheses, or changes in timing or sequencing of articulatory gestures. Strictly speaking, speech errors such as slips of the tongue do not fit into Javkin's system at all, and it is questionable not only whether these should be seen as sound changes in themselves, or if they ever actually lead to sound change. However, the stop epenthesis example discussed above is usually described as a result of a change in timing of articulatory gestures (cf. Ohala 1974a), and therefore could arguably be considered within this category. To the extent that this phase is psychological, it is to be considered 'pre-phonetic' - and, while it may be possible that some sorts of sound



change are mediated in this phase, it would seem that for the most part it is other developments, such as those we have called substitutions, that originate here. This approach has the advantage of allowing a means of distinguishing between such sporadic or intermittent kinds of change as slips of the tongue, and 'regular' changes like the stop epenthesis example. It may be worth noting in passing another current view on the issue of stop epenthesis, that of Fourakis and Port (1986), who attribute this change to a variation in 'phase rules'; however, my comments and the views of Catford on rule oriented approaches, expressed above (p. 4), are equally valid for 'phonetic' rules as for phonological ones. That is, before even such rules as those discussed by Fourakis and Port can be added to a speaker's grammar there would have to have been a certain amount of variation which led to a reorganization of the timing of the relevant articulatory gestures.

The second of Catford's types of change occurs in the "neuromuscular phase". Changes during this phase originate in constraints on the activation of muscles. As an example, it is suggested that the maximum number of "major glottal adjustments" is about five per second (p. 23), and that the change referred to as Grassman's Law<sup>13</sup> is a result of this physiological constraint. Whether this is a satisfactory explanation for that change is questionable, as many other hypotheses (both phonetic and non-phonetic) have been presented to account for it. It seems reasonable to assume that such kinds of 'hardware' constraint would have prevented the existence of the situation that originally gave rise to the change described by Grassman's Law, or other similar situations. This type of constraint is, in principle, directly observable through phonetic research techniques, but it is difficult to think of any instances of change that could be satisfactorily attributed to it, in the manner expressed by Catford. On the other hand, changes in activation of muscles involved in speech production could indeed lead to sound change (cf. Pagliuca and Mowrey 1987).

The third phase is the "organic phase", and refers to "gross movements of whole organs" (p.23); potentially resulting changes are those such as the development

---

<sup>13</sup> Grassman's Law describes the dissimilation of aspirated stops followed by other aspirates in the same word, eliminating all but the last aspirate in a word; e.g., PIE \**bhudhyetoy* → Skt. *budhyatē* (example from Hock 1986: 111). Catford's claim is that the maximum number of "major glottal adjustments" is about 5 per second, which presumably makes difficult a change from the glottal configuration required for (in the example here) voiced aspirate *bh* to voiced *u* and back to voiced aspirate *dh* - two changes in perhaps 300 msec. Ohala (1989) provides a different explanation for this change, in attempting to account for dissimilations in general. This is examined in §1.8.

of affricates from palatalized velars. Changes of this sort straightforwardly fit into Javkin's category of articulatory-based changes.

Catford's fourth phase is the "aerodynamic phase", and it is suggested that many changes related to initiation and phonation are likely to have originated in aerodynamic considerations. These factors are determined by articulatory characteristics, and therefore changes of this type may also be considered to fall within the category of articulatory based changes.

The fifth phase for Catford is the "acoustic-auditory phase", described as producing changes caused by acoustic similarity resulting in auditory similarity. This category of change is the same, therefore, as what is referred to as acoustically-based change in Javkin's typology. There does not seem to be any category for Catford corresponding to Javkin's auditory-based changes.

In summary, the two taxonomies largely parallel each other. Catford goes farther than Javkin at the production end of the transmission process in wanting to take into account psychological and neurological events, while at the perception end, it is Javkin who goes farther, in suggesting that a certain class of sound change originates entirely in the auditory system. If one excludes as being non-phonetic (or pre-phonetic) the psychological events referred to by Catford, then his first three categories are all subsumed by Javkin's articulatory-based class of change. The question therefore arises as to whether these three are usefully distinguishable subtypes within this class.

Setting aside for the moment changes associated with aerodynamic characteristics, we see, on one hand, innovations resulting from a change in the interaction of articulatory gestures necessary for the production of one sound segment, e.g., in stop epenthesis where the synchronization of gestures needed for the production of a nasal consonant is lost. On the other hand, are innovations resulting from the interaction of articulatory gestures for adjacent sound segments, e.g., the palatalization of velars. It is arguable that stop epenthesis is also the result of the interaction of gestures for adjacent sound segments in that the early raising of the velum may be done in anticipation of the following non-nasal. However stop epenthesis is still describable in terms of the gestures needed for one segment, whereas the palatalization of velars is not. Therefore, the distinction between the two appears to be motivated, at least to a certain extent.

Innovations occurring during Catford's aerodynamic phase are not so easily distinguishable. Devoicing of intervocalic stops, a change in phonation, for example, can be seen as resulting from the interaction of the different muscular gestures controlling the duration of stop closure and vocal fold activity. Although it is useful to recognize certain changes as having an aerodynamic component, to the extent that aerodynamic characteristics are determined by articulatory factors (e.g., devoicing of intervocalic stops), it seems difficult to justify setting these changes off as a separate class or sub-class of change within the context of the present system.

### 1.5. A Proposed Taxonomy of Sound Change

Through examination of both Javkin's and Catford's classifications of sound change, we are able to arrive at a taxonomy which combines the common points of both, while at the same time developing one which as much as possible is based solely on phonetic criteria. This classification recognizes three (phonetic) phases in the speech transmission process: articulatory, acoustic, and auditory, with the possibility of specific kinds of perturbations occurring in each of these stages, and therefore indicating three corresponding categories of sound change. This is not to suggest that the three stages are independent of each other, for clearly they are not. It follows, then, that there is not necessarily a clear boundary between the three types of change, and that the main purpose of the 'taxonomy' is not purely and simply classification. What the taxonomy does do is to indicate which phonetic factors may play a role in any given sound change, and thereby provide a set of guidelines for the phonetic investigation of sound change.

In the case of one class of change, those that are primarily articulatory in nature, it has been possible to further sub-categorize these according to whether they are the result of facts internal to one sound segment or the interaction of adjacent sound segments. This division also seems to be well motivated in that it seems to correspond to the traditional distinction between 'context-free' and 'context-sensitive' changes (cf. Catford 1974: 24). This system of classification is presented in Figure 1.5a.

The theoretical framework presented in the preceding pages has several implications for the study of sound change specifically, and for phonetics and phonology generally. In accepting the distinction presented between the origin and propagation of sound change, it is possible to view from a different perspective such time-honoured controversies as that concerning the gradualness or abruptness of sound change. In considering sound change first as a phonetic process, we gain not only a

greater understanding of this aspect of language, but also of the role of articulation and audition in sound change, as well of the larger issue of the relation between phonetics and phonology. I turn now to examine briefly these issues.

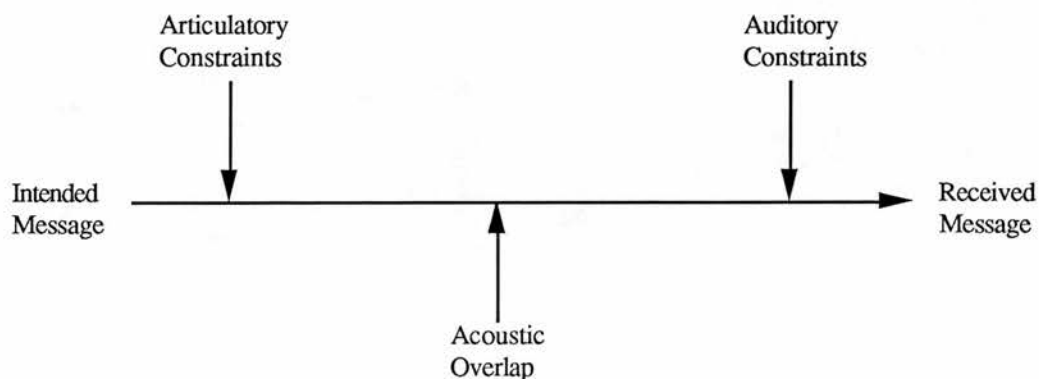


Figure 1.5a: Sound change from a speech transmission perspective. Possible articulatory constraints include factors internal to the production of a sound as well as coarticulatory phenomena; acoustic overlap refers to the possibility of confusion resulting from the many-to-one relation between vocal tract configuration and acoustic output; auditory constraints are those factors internal to the auditory process itself.

### 1.6. Graduality and Abruptness of Sound Change

The question of whether sound change proceeds gradually and imperceptibly or in an abrupt fashion has engendered a debate which spans most of modern linguistic history. The rigorous notion of sound change first formulated by the Neogrammarian school in the 1870-80s, asserted the phonetically gradual nature of sound change. The distinction drawn by the Neogrammarians between gradual change and abrupt change corresponded largely to the difference they saw between sound change and sound substitution. That is, sound change was phonetically gradual, proceeding by imperceptibly minute steps, whereas sound substitutions were phonetically abrupt. This notion of graduality was intimately related to the regularity hypothesis, and a consequence was the belief that sound change is unobservable.

An immediate challenge to the Neogrammarian hypothesis (or regularity hypothesis, as it later came to be known) came from that school of linguistics referred to as the dialect geographers, in particular Schuchardt and Gilliéron and their followers. The root of their rejection of the Neogrammarian hypothesis was in their research into minute variations among dialects, which revealed what they considered to be far too

many exceptions for the Neogrammarian hypothesis to hold. The kind of variations they observed seemed to occur at the level of individual words, thereby contradicting any notion of regularity of change, and leading to the now famous slogan ‘every word has its own history’. Although the issue has not always been in the forefront of linguistic theory, controversy has surrounded it ever since.

The debate was given new life by Wang (1969), who examined four possibilities as to how a sound change might proceed within the individual:

- 1) phonetically abrupt and lexically abrupt
- 2) phonetically abrupt and lexically gradual
- 3) phonetically gradual and lexically abrupt
- 4) phonetically gradual and lexically gradual

By ‘phonetically abrupt’, Wang meant that sound X would go to sound Y (two sounds sufficiently different to be potentially phonemically distinct) “without passing through minute intermediate stages” (1969: 14). With regard to diffusion through the lexicon, ‘abrupt’ referred to the possibility of all morphemes containing X undergoing the change to Y simultaneously, rather than successively. The first of the four above possibilities, Wang considered to be “obviously unacceptable” (1969: 14), although it is by no means clear that all historical linguists would agree with this rejection; it seems, for example, to be implicit in the generative view that sound change is precipitated by rule change (King 1969, Kiparsky 1988). Janson (1983) provides reasons divorced from the generative position as to why this possibility should not be rejected. The third possibility represents the Neogrammarian hypothesis, which Wang found unsatisfactory, as it could not account for the lexically gradual spread of change as observed in Chinese. Both possibilities (2) and (4) fit with his notion of lexical diffusion, but of these Wang regarded (2) to be more appealing than (4), taking it as ‘given’ that the phonetic implementation of a sound change is abrupt rather than gradual.

Hoenigswald (1960: 72) had earlier rejected the claim for graduality, saying, “In the almost total absence of large-scale questionnaire supported observations which would have to be extended or repeated over generations of speakers in a community, such a picture can only be guesswork”. There is a certain validity to Hoenigswald’s argument, particularly his insistence on large-scale, transgenerational research, but the absence of such research is not grounds for rejecting the notion of graduality, it only



demands that the question be kept open until such research is done. And it is precisely this sort of work that Labov and his co-workers (much of which is summarized in Labov 1981) and Janson (1983) have undertaken. Labov has concluded that sound change can indeed proceed by infinitely small steps, at least in the case of certain vowel changes. Janson's research has shown that change in perception as well as production can occur gradually, but he also finds it necessary to re-examine what is meant by 'gradual' and 'abrupt'. Finding the concept of abrupt change incompatible with lexical diffusion, Janson (1983: 20) adopts (following Labov 1981) a category of phonetically 'discrete' change. These are changes which are not abrupt jumps from one articulation to another, wholesale, but neither do they proceed by imperceptibly small steps. Rather, they are changes in which the old and new articulations are in 'free variation' for a period of time, with the innovation gradually winning out. It is therefore questionable whether truly abrupt changes, i.e., where the old articulation gives way immediately and completely, actually do exist.

The framework outlined in the preceding sections allows us to see that certain types of sound change may indeed be gradual, while others are abrupt, or discrete. Those who argued on the side of abruptness often took as evidence examples involving huge shifts in articulation, for instance, from velar to labial. It is these kinds of change that by and large seem to fit into the category of auditory or acoustically-based changes. On the other hand, changes that do seem to proceed gradually, or in a step-by-step fashion, tend to fall into the class of articulatory-based changes. Catford (1974: 23), as an example of a gradual change, presents the loss of [k] in initial [kn] clusters in English, drawing his evidence from the survival of the intervening stages in various regional pronunciations of words such as 'knee' and 'knife' in Scotland (although it might be argued that there is an element of discreteness in this development as well, particularly where the change from [kn] to [tn] comes into play). Another example would be the well attested change of [k] to [s] or [ʃ], which often can be seen to have intervening stages of [c] and [tʃ]. While these changes may not proceed by infinitely small steps, it is clear that they do proceed gradually. The limits on the size of the steps in these cases may be determined by an interplay of articulatory and perceptual factors. Still other articulatory based developments, such as the lenition of intervocalic consonants can be seen to proceed gradually, to the extent where it is probably misleading, let alone difficult, from a phonetic standpoint, to talk of the change occurring in discernible stages or steps.



### 1.7. Ease of Articulation

The notion that sound change is the result of a tendency for greater ease in articulation goes back at least to the Neogrammarians, though for them it was no more than secondary in importance, as Paul (1888: 47-8) makes clear:

It is of great importance never to lose sight of the fact that the consideration of convenience in each production of sound affords in every case only a very subordinate and secondary cause... It is equally mistaken to refer the appearance of a sound change in each case to some particular manifestation of laziness, weariness or neglect, and to ascribe its non-appearance in other cases to some special care and observation.

Despite Paul's warning, the notion of ease of articulation, or economy of effort, has been maintained, and in fact often made primary, as a factor in sound change, ever since. This may have been largely due to the influence of Martinet, as it fit well into his functional framework, as mentioned above regarding conditioned changes, as the Principle of Least Effort. More recently, Ladefoged (1982) has invoked the notion in tandem with the Principle of Sufficient Perceptual Separation as a means of explaining phonological patterning generally.

The notion of inherent constraints as outlined above is often taken to be equivalent to 'ease of articulation' when examining sound change (despite the fact that the former also includes constraints in the auditory system). This connection is explicitly denied by Ohala (1974a: 368) who, in accordance with Paul, rejects the idea of ease of articulation being a factor in sound change in that it implies laziness on the part of speakers: "[sound changes] are caused by the inherent anatomical, physiological, and neurophysiological constraints and characteristics of all vocal tracts - even those ~~of~~ hard-working speakers". For ease of articulation to play a role, then, it would seem to be necessary to show that innovations somehow originate with the lazy and sloppy and then subsequently spread to the hard-working and careful.

Vincent (1978) has rejected the ease of articulation argument on other grounds, as being essentially teleological. That is, the notion of ease of articulation suggests that sound change is goal-oriented and purposeful. In other words (in an admittedly extreme characterization), one might argue that speakers consciously decide (collectively?) to adopt a new articulation in order to make the task of speaking less difficult. While not accepting this view, Vincent sees as plausible a distinction made by Andersen (1973) between teleology of function and teleology of purpose, which

would permit Martinet's concept of internal pressure (which can also be construed as being teleological) to explain some types of change<sup>14</sup>.

The arguments of both Ohala and Vincent against explaining sound change through reference to ease of articulation are reasonable. To argue, on the other hand, that certain sound changes are the result of constraints inherent to the speech production and perception system does not suggest that speakers are inherently lazy or that they consciously choose to direct the evolution of their language. It is, instead, a recognition of the physical aspects of language and that much of what we do when speaking or listening is automatic, or subconscious.

### 1.8. The Role of the Listener

It has become clear, particularly through the work of Ohala (esp. 1981, 1989), that an understanding of sound change will require an understanding of both speech production and speech perception; in other words, the role of both the speaker and the listener. Generally, where it has considered either, work on sound change, has focussed on production rather than perception, and again this may perhaps be traceable to the writing of Herman Paul, who by and large denied the importance of perceptual factors, saying:

A single inaccuracy of ear cannot possibly have any lasting results for the history of language. If I do not accurately catch a word from any one who speaks the same dialect as myself, or another with which I am well acquainted, ... then I supply the word in question according to the memory-picture which I have in mind (1888: 62).

As we saw above, however, a crucial aspect of the Ohala-Javkin model of sound change is the role of the listener. Ohala argues that the listener is not just a "pipeline for change", but rather, since "he has to use the acoustic/auditory information received from other speakers to figure out how to make the same sounds himself", (1981: 179), that the role of the listener is some how pivotal in sound change. (Janson, 1983 and elsewhere, has also devoted much effort to examining the role of perception in sound change). Ohala (1981, 1989) has described three possible roles the listener might play.

---

<sup>14</sup> Ohala (1989) rejects even this form of teleological argumentation because, among other reasons, it is "too easy", an unsound and extravagant assumption, "which deflects us from seeking more immediate causes".

In the first of these, listeners factor out the phonetic variability that could potentially lead to sound change. This either happens automatically - i.e., the variation is not normally perceived at the conscious level - or deliberately, as is suggested by Paul, in the above quotation. A typical example of automatic factoring out of variation offered by Ohala is the case of an affricated release of a stop when followed by a high front vowel, where the affrication is ignored by the listener, who is familiar with these kinds of contextual effects. This type of activity on the part of the listener would undoubtedly be the most common of the three - the role that leads to preservation of the status quo.

The second situation is one in which the listener unknowingly participates in sound change by duplicating the variation. The most straightforward instance of this would be a result of the many-to-one relationship that exists between vocal tract configuration and acoustic output - instances of change resulting from acoustic factors which lead to perceptual confusion, or 'misapprehension', as described earlier. There are many examples of change resulting from this sort of phenomenon - one would be the development of [θ] to [f] dialectally in English. In general, these changes are characterized by Ohala as instances of 'hypocorrection' - the factoring out referred to above (in Ohala's terms, the application of 'corrective rules') fails to take place, and what was formerly phonetic variation becomes phonologized.

The third possible role involves what Ohala refers to as 'hypercorrection' - the unrequired implementation of corrective rules on the part of the listener. In these instances, the listener "erroneously [attributes] a given detail to the surroundings rather than to the actual object it is a property of". Many (perhaps all?) cases of dissimilation are thought by Ohala to arise through hypercorrection. The change known as Grassman's Law (discussed earlier) can, from this perspective, be described as the listener interpreting the aspiration on all but the last of a succession of aspirated consonants as being unintentional (i.e., a predictable contextual effect) on the part of the speaker, and therefore factors it out.

It is reasonable to assume that the listener must play some part in sound change, and not simply a passive one. However, one cannot help asking at what point this role begins. In theory, at least, only one speaker's articulation would need to be perturbed, in the case of articulatory based changes, for a 'snow-ball' effect to begin. It seems rather unlikely that this would ever actually be the case, and more probable that the pronunciation of all, or at least most, speakers might have changed before the

perceptual re-adjustment occurred. One may well wonder, then, (still with the example of articulatory-based changes) at what point does the misperception, or 'reinterpretation' occur? In the case, for example, of the palatalization of velars in the environment of a front vowel, we could well assume that at some stage prior to the palatalization process, the front vowel may have become 'more front', in order for it to start 'pulling' the consonant forward. Is this what the listener hears and reinterprets, or is it the shift in position of the consonant? The possibility of a shift in over-all articulatory setting, as proposed for example by Hagège and Haudricourt (1978), also exists and is in need of more investigation. The factors that lead to the establishment of different articulatory settings in different languages or dialects are not well known, and could lie well outside the directly phonetic or linguistic. It is hard, however, to envision these gross sorts of change to be a result of perceptual factors.

Other questions, as well, may be raised regarding the role of the listener. It is not clear in all cases, for example, what factors might lead to the phenomenon referred to as hypocorrection. The loss of a conditioning environment is one possibility, and this would have its own accounting depending on the change (a separate one - see the discussion earlier regarding vowel nasalization) in question. However, the failure of the listener to detect an existing environment is another possibility raised by Ohala, and although reasons could be proposed for individual cases, this one would seem somewhat more difficult to understand.

Similarly, one may question the operation of hypercorrection. And although, as Ohala suggests, this hypothesis leads to interesting predictions, which seem to be borne out<sup>15</sup>, other questions arise, particularly with regard to the directionality of dissimilation. If one accepts the assumption that speech processing proceeds in a left-to-right manner, it might reasonably be concluded that it should be the rightmost element to dissimilate - that the 'redundant' occurrence of a feature would be interpreted as being subsequent to its first occurrence in a given situation. As we have seen with Grassman's Law, though, it is the later occurrence which survives. Ohala (1986; see also Javkin 1979) counters this argument by suggesting that since dissimilations of this type are, in essence, undoing what is (mis-)interpreted as assimilation, and since assimilation is primarily anticipatory, then right-to-left should be the natural direction. At the least, it seems one could expect that, if dissimilatory changes do indeed result

---

<sup>15</sup> For example, that dissimilatory processes cannot introduce any new segments into the phonological system of a language, and that these processes involve only features whose cues can be spread in time. Where these predictions are not entirely borne out they are, at least, readily testable.



from a perceptual processing phenomenon such as hypercorrection, that the direction of dissimilation would be consistent across languages. However, this appears not to be the case, as instances of dissimilation in both directions are readily available in the literature. On the other hand, accepting Ohala's proposal as a hypothesis does have interesting implications for a theory of speech perception, which again are eminently testable.

### 1.9. Sound Change, Phonetics, and Phonology

It has not been the intention here to claim that all innovations in a phonological system are entirely and only the result of mechanistic phonetic factors. However, the term 'sound change' has been adopted here to refer to those developments which are in some way phonetically mediated. The framework presented in this chapter provides a set of constraints on the systematic phonetic investigation of sound change. These constraints, as Ohala (1974b: 268) points out, are stricter, more numerous and less *ad hoc* than those on possible psychological explanations of sound change. It follows, then, that the starting point for investigating sound change should be the realm of phonetics; when this is exhausted, one may try other forms of explanation. This line of reasoning is easily extendable to other aspects of phonological investigation.

By the same token, it is apparent that phonology also has contributions to make to the study of phonetics; again, as Ohala (1983: 189) argues,

...[not only does] the study of the physical aspects of speech assists phonology but also that phonology can return the favor: A careful, perhaps inspired, analysis of sound patterns in languages can help us to discover and understand some of the complexities of speech production.

Critics of the phonetic approach to investigating phonological innovation have raised the question as to why, given the appropriate conditions, the expected sound change, on occasion, does not occur (i.e., the actuation problem). The failure of an 'expected' change to manifest itself points to the fact that undoubtedly a complex of factors contributes to both the origin and propagation of any given sound change. The reasons for the non-occurrence of a change will likely be found among these factors, and it is, at this stage in our understanding of sound change, difficult to determine which factors should be given priority. From the phonetic point of view, it is argued below (Chapter Five) that, on more or less casual observation, what appear to be identical conditions may, on deeper inspection, prove not to be, hence a change may be triggered in one case but not another. Moreover, many innovations or variations, for

example, appear to be related to syllable structure; but are these due to phonetic or phonological qualities of the syllable? The widely attested loss of final consonants, for instance, is said to occur because final position is phonologically 'weak'. However, it is also well known (cf. Ohala and Kawasaki 1984) that VC transitions are less distinct, perceptually less salient, than CV transitions, therefore rendering the consonant in question less recognizable and more prone to loss. So while syllable structure can be seen to play a role in phonological innovation, the interplay with phonetic factors is often critical. It seems apparent from cases such as this that phonetics and phonology are in fact indispensable to, indeed inseparable from, each other.

In this chapter, I have outlined a theory of sound change that views this phenomenon from a phonetic perspective. This view is by no means the only possibility (i.e., still from a phonetic perspective), as is shown below, in Chapter Five, when the work of Pagliuca and Mowrey is considered in more detail. The view presented by Ohala, however, is perhaps the most widely accepted among interested phoneticians, and certainly the most comprehensive to date. It will form the basis of our phonetic investigation of consonantal sound change in the Lower Cross languages. Before proceeding to examine the phonetic characteristics of the consonant systems of these languages (Chapter Three), the next chapter presents a sketch of their phonological characteristics. In particular, those aspects which may play a role in understanding the evolution of their consonant systems are examined.



## Chapter Two

### An Overview of Lower Cross Phonology

#### 2.0. Introduction

Of the various Lower Cross languages, Efik has been the subject of the most detailed phonological examination (Cook 1969a,b, 1985). Ibibio phonology has received some attention, primarily in the form of doctoral dissertations (e.g., Kaufman 1968, Boys 1979, and Urua 1990), but also in Essien's (1990) *Grammar*<sup>16</sup>, and the phonological system of Oro has been sketched by Kuperus (1978) *en route* to describing the verbal system of that language. Of the others, a phonemic inventory of Obolo is presented by Faraclas (1984a) in his *Obolo Grammar*, and Anaang, Ekit, Ibino, Nkari, and Usakade, as well as Efik, Ibibio, and Oro have been the subjects of undergraduate long essays at the University of Calabar. An examination of these works, together with data from the other Lower Cross languages, reveals that there is substantial similarity among Lower Cross phonological systems. It is therefore possible to present a broad outline of the phonological characteristics of the Lower Cross languages. As it is not my aim to attempt a detailed phonology for all (or any) of the languages of the group in this dissertation, the treatment here will first outline the consonantal phonologies of the group, and then look primarily at work done on Efik, Ibibio, and Oro to focus on selected issues which are most relevant to the larger goals of the dissertation, and be of most use to the reader.

---

<sup>16</sup> Essien's *A Grammar of the Ibibio Language* (1990) has a chapter dealing with phonology; this and Urua's (1990) dissertation appeared too late to be examined here.

## 2.1. Lower Cross Consonants

Detailed analyses have not been done to determine precisely the phonemic inventories of all LC languages. However, the same or similar characteristics are to be found in all languages of the group, making it possible to give a generalized account of certain aspects of Lower Cross consonant phonology.

A convenient starting point is a statement of what appear to be the phonemic consonantal inventories across the group - though it is by no means clear that such an approach is in fact the most desirable. Kaufman (1968) questioned the value of a phonemic approach, saying that, "the concept [of the phoneme] is unnecessary and misleading for Ibibio segmentals and impossible for Ibibio tones" (p.10). Cook (1969b), while utilizing a descriptive phonemic approach, voiced similar concerns, suggesting that his analysis could be readily translated into, and perhaps be even more plausible in, a Generative framework. Readers familiar with Firth's *Prosodic Phonology* will certainly recognize that many aspects of Lower Cross phonology, particularly regarding the distribution and realization of consonants, might be very satisfactorily handled within that framework. This is, at least to a limited extent, acknowledged here and throughout the dissertation by examining the various aspects of Lower Cross consonants with specific regard to their position within the word. However, as the aim of this chapter is primarily to provide the reader with a sufficient descriptive introduction to the Lower Cross languages, questions of phonological theory may perhaps be best set aside for the present. Despite this, it will be apparent that there are a great many issues of theoretical interest in Lower Cross phonology.

### 2.1.1. Distribution and realization of consonants in initial position

Throughout Lower Cross, all consonant phonemes in a given language may occur in initial position<sup>17</sup>. Two exceptions to this so far discovered are a contrast between /kp/ and /p/ in at least some dialects of Ibibio in medial position (Essien 1984b), where /p/ ([p]) does not occur initially, and a contrast between /k/ and /ŋ/ in Ekit ([ʔ] does not occur initially). It is probable that this latter contrast may also be found in Etebi, and those Ibibio dialects spoken to the south-west of Ekit. Particularly regarding the /kp/ ~ /p/ contrast in Ibibio, its functional load (i.e., the number of words distinguished by the contrast) appears to be minimal.

---

<sup>17</sup> 'Initial', for the moment, can be taken to refer to word-initial, or 'post-pausal' position. However, only second person singular imperative forms in Lower Cross languages normally (there are exceptions) begin with a consonant. The concept of initial as opposed to intervocalic, as will become clear, is not a straightforward one for these languages.

Despite this common characteristic (i.e., that throughout Lower Cross essentially all consonant phonemes may occur in initial position), the size of consonant inventory is quite variable across the group. The minimal inventory can be said to be that of Efik, having 13 consonants (Cook 1969b), and the largest that of Obolo, with 21 consonants (Faraclas 1984a). The inventories of all LC languages, as reflected by occurrence in initial position, are presented in Table 2.1a. Known cases of dialect variation are indicated with ‘~’; for example, the Ikot Ekpene dialect of Anaang generally does not have /kp/, but /p/, whereas the other Anaang dialects have /kp/. The three main dialects of Anaang are also distinguishable by a /d~r~l/ alternation. Phones occurring in initial position, but of uncertain phonemic status, are enclosed in parentheses, while those which are clearly allophonic (e.g., Efik [r], Oro [g v z]) are omitted.

Anaang	/m n ɲ ŋ b d~r~l g <sup>w</sup> t k p~kp f s ʃ~dʒ~j w/
Ebughu	/m n ɲ ŋ b d gb g <sup>w</sup> t k p~kp f s dʒ j w/
Efai	/m n ɲ ŋ b d t k kp f s (l) j w/
Efik	/m n ɲ ŋ b d t k kp f s j w/
Ekit	/m n ɲ ŋ b d t k kp f s dʒ~j w/
Enwang	/m n ɲ ŋ b d p t k f s v (dʒ) l j w/
Etebi	/m n ɲ ŋ b d t k kp f s (dʒ) j w/
Ibibio	/m n ɲ ŋ b d t k kp f s j w/
Ibino	/m n ɲ ŋ b d p t k kp k <sup>w</sup> f s tʃ (r) l j w/
Ibuoro	/m n ɲ ŋ b d (g <sup>w</sup> ) t k kp s f (dʒ) (r) j w/
Iko	/m n ɲ ŋ b d g (gb) g <sup>w</sup> t k kp tʃ s f z l w/
Ilue	/m n ɲ ŋ b d g <sup>w</sup> t k kp s f (r) l j (w)/
ItuMbuzo	/m n ɲ ŋ b d t (p) k kp f s tʃ j w/
Obolo	/m n ɲ ŋ b d g gb g <sup>w</sup> t k kp k <sup>w</sup> f s tʃ dʒ r l j w/
Okobo	/m n ɲ ŋ b d p t k f s tʃ l j w/
Oro	/m n ɲ ŋ b d t k kp f s l j w/
Uda	/m n ɲ ŋ b d p t k (kp) p f s v (r) l j w/
Ukwa	/m n ɲ ŋ b d t k kp f s j w/
Usakade	/m n ɲ ŋ b d t k kp f s tʃ β j w/

Table 2.1a: Consonant inventories of Lower Cross languages as determined by occurrence in stem initial position. ‘~’ indicates dialect variation (e.g., Anaang /p/ corresponds to /kp/ dialectally), and parentheses indicate uncertain phonemic status.

Detailed comments on the phonetic realization of consonants in initial position are given in §3.7; for the present it is sufficient to note that these are normally ‘strongly’ realized; e.g., stops normally involve complete closure and voiced stops are fully voiced.

### 2.1.2. Final position

In final (pre-pausal) position, the range of permissible consonants is drastically reduced, and here, despite variation in inventory size across the group, as shown above, it is the same set of six possible phonemes which may occur. Phonetically, only voiceless, normally unreleased stops [p<sup>-</sup> t<sup>-</sup> k<sup>-</sup>] occur, as well as the nasals [m n ŋ]. For Efik, Cook (1969b)<sup>18</sup> has phonemicized these as /b d k m n ŋ/. Whether this phonemicization is valid for the other languages of the group has not been tested in all cases. However, his arguments for this analysis of Efik are reasonable and likely are applicable to the remainder of the group. Certainly scholars working on Ibibio (Kaufman 1968, Boys 1979, Essien 1984a, b) have reached similar conclusions, as has Kuperus (1978) for Oro. For Obolo, Faraclas (1984a) reports [p t k m n ŋ] occurring finally, though [p] is said to be excluded in some syllable types. It is not clear whether the symbols used are intended to represent phonemes, though it is stated that /b/ is ‘p’ word finally (i.e., orthographically).

Examination of data from the rest of LC languages shows that in all of these, for the most part [p<sup>-</sup> t<sup>-</sup> k<sup>-</sup> m n ŋ] are the only possible consonant phones in final position. The following minor exceptions have been found. First, in Ekit, Etebi, and Uda, /ŋ/ may also occur finally, corresponding to /t/ or /k/ in the other languages. The replacement of /t/ and /k/ by /ŋ/ in these languages presumably represents a step towards the loss of these final consonants. Second, in at least Efik (reported by Ward 1933), Anaang, Ibibio, ItuMbuso, and Ukwa, final /b/ or /d/ may occasionally (rarely) be voiced, or partially voiced, rather than voiceless; these instances are apparently in free variation with the expected voiceless stops. It is possible this reflects an earlier voicing distinction in final position, though certainly no phonemic contrast involving voicing has been reported here synchronically.

Given that /b d k m n ŋ/ ([p<sup>-</sup> t<sup>-</sup> k<sup>-</sup> m n ŋ]) are the six basic consonants that may occur in final position in any Lower Cross language, it is also worth noting here the extent to which they occur across the group, as this is variable. Many of the languages

---

<sup>18</sup> Cook also includes /j/ in this set for Efik; its status here is somewhat controversial, and the question is returned to below.

of the group are in the process of losing final consonants, a not uncommon phenomenon among Niger-Congo languages generally. This process is most advanced in those languages occupying the southeastern area of the Lower Cross region. In languages such as Ekit, Ebughu, Oro, and Usakade, approximately 35 - 40% of words examined ended with consonants, whereas Anaang, Ibibio and others which extend into the northern region have about 60 - 65% of words being consonant-final. Although the question of final consonant attrition is not treated in depth in this work, it is returned to in Chapter Five, where it is shown that velar consonants tend to survive longest.

### 2.1.3. Intervocalic (ambisyllabic) position

In intervocalic, or ambisyllabic, position<sup>19</sup>, again throughout Lower Cross, we find the same distribution and essentially the same phonetic realization of consonants. That is, if Cook's analysis may again be assumed to be valid for the other languages in the group, only /b d k m n ŋ/ may occur in this position. This is not an unreasonable assumption; again, analysts of Ibibio and Oro have reached the same conclusion, and data available for the other languages in the group do not readily present an attractive alternative analysis. Main phonetic realizations are as follows<sup>20</sup>:

/b/	>	[b ɸ β]
/d/	>	[d ɾ ɹ]
/k/	>	[ǵ ʏ ɰ ʀ]
/m/	>	[m m̥]
/n/	>	[n ɳ]
/ŋ/	>	[ŋ ɲ ɰ]

Not all of these variants necessarily occur with the same degree of frequency across LC languages; indeed some may be absent in a given language (i.e., for a given phoneme). For example, in Ibino, [ɹ] occurs more frequently as a realization of ambisyllabic /d/ than it does in Efik, where [r] is by far the more frequent realization. The basic statement holds, however, that in ambisyllabic position underlying stops are realized as taps, fricatives, or approximants - i.e., articulations are reduced with regard to both duration and degree of contact. The nasals, too, also appear to reduce, but to a lesser degree. In many, if not all, Lower Cross languages, /j/ may also occur in final

<sup>19</sup> Like the term 'initial', the term 'intervocalic' needs clarification when used for Lower Cross. It is argued below that there are two types of intervocalic position in LC; what I refer to here as 'intervocalic' is but one of these, and is best regarded as ambisyllabic position.

<sup>20</sup> The diacritic '˘' is used to indicated short duration, or a tapped realization. More discussion of this comes in Chapter Three.

position; whether this is to be treated as a consonant or a semi-vowel in this position is debatable, and the question is returned to below.

We see, then, that throughout the LC group, despite some variation in consonant inventories, the same or similar distributional and realizational constraints on consonants obtain. And of particular interest, the same restrictions apply to consonants occurring in final and ambisyllabic positions. Both Ward (1933) and Cook (1969a, b, 1985) are of the opinion that the Efik consonant system is an interesting one, largely on account of its asymmetrical distribution and the relation of this distribution to syllable structure. Kaufman (1968), Boys (1979), and Essien (1984a, b), reveal similar characteristics for Ibibio, as do Kuperus (1978) and Faraclas (1984a) for Oro and Obolo, respectively. Subsequent sections of this chapter examine how Lower Cross consonant phenomena have been treated by individual scholars, and as there appears to be a relation between consonant distribution and the syllable, discussion of syllable structures is included. Before this, however, a synopsis of Lower Cross vowel and tone systems is presented.

## **2.2. Vowel and Tone Systems in Lower Cross**

There is perhaps more variation in the vowel systems found in LC languages than was seen for the consonants, but less for the tonal systems (at least with regard to lexical tone). This is no more than an impressionistic view at this point, though, as little work has been done on LC vowels and tones (again with the exception of Efik, whose vowel and tonal systems have been analysed in detail in Cook 1985).

### **2.2.1. Vowels**

Generally speaking, Lower Cross languages have relatively small and relatively symmetrical vowel inventories; the six basic vowels of the Obolo system, /i e a ɔ o u/, are common to all, though most have slightly larger inventories. Efik is described as having a 7-vowel system, /i e ε a ɔ o u/, though the functional load of the /e/ ~ /ε/ opposition is small. In other languages, e.g., Ibibio, Anaang, as well as Obolo, this opposition is non-existent, whereas Kuperus (1978) provides evidence for Oro having the 7-vowel system. Both Ibibio and Anaang, despite lacking this opposition, demonstrably have 8 vowels; in the case of Ibibio, Essien (1984b) in fact argues for 8 to 10 vowels, depending on dialect.

The controversy over the number of vowels in a given system (other than the above mentioned marginal contrasts) hinges largely on the status of central or



centralized vowels, e.g., [ɪ ə ʌ ɔ]. In all LC languages (though to a much lesser degree in Usakade), vowels in closed syllables are shortened and centralized (most noticeably /i u o/). In Efik, this is clearly allophonic variation, however in Ibibio, there does seem to be evidence to attribute phonemic status to some central vowels, and this is possibly true of other members of the group, such as Ibino and Ibuoro. Whether the smaller system as represented by that of Efik, or an expanded one, more closely approximates that of Proto-Lower Cross is a matter for further research.

Variations in inventory aside, we also find differences in the phonemically contrastive use of length<sup>21</sup>. Anaang, Ekit, Ibibio, Ibino, Iko, Obolo and possibly Ibuoro, all have phonemically contrastive vowel length. Faraclas (1984a) has therefore analysed the Obolo system as having 12 vowels, though it seems equally plausible at this point to argue for six vowels and a phoneme of length, or an analysis advocating double vowels. The possible existence of vowel length in the other languages has not been sufficiently investigated, but of these, Efik, Okobo, Oro, and Usakade clearly do not have a length distinction.

Throughout the group we find the occurrence of the approximants /j w/ in post-initial (post-C<sub>1</sub>) position, except for Obolo which has only /j/ (Faraclas 1984a)<sup>22</sup>. Whether these are to be analysed as vowels or consonants is a controversial; as discussed below, Boys and Kaufman adopt differing approaches for Ibibio. Boys analyses them as semi-vowels, and would therefore see a sequence of either of these plus vowel as a diphthong. Kaufman, seeing them as full vowels, presumably would argue for the existence of vowel clusters within her structural syllable (discussed below). Both Cook and Kuperus, for Efik and Oro, respectively, prefer to analyse these as consonants, though recognizing that phonetically they are frequently realized as full vowels, [i u]. This issue is perhaps resolvable through an adequate theory of the syllable in LC (e.g., one which permits vowel clusters with non-syllabic vowels), but will not be explored in depth here (but see §2.4, below).

Regardless of how these are analysed, in many, if not all, LC languages there are other sequences which are arguably diphthongs, these being combinations of vowel plus approximant in open syllables. These are invariably closing and fronting diphthongs, e.g., /ej, aj, ɔj/, except for Ekit, which also has /ow/. Whether these are,

<sup>21</sup> The phonemic use of vowel length needs to be distinguished from a morphosyntactic use of length to signal 'plurality' - i.e., repeated actions or actions of prolonged duration - on verb stems.

<sup>22</sup> Faraclas analyses potential /kw/ sequences as /k<sup>w</sup>/.

in the end, considered to be diphthongs or not may depend on how the syllable is analysed.

Vowel harmony is also a feature of most, if not all, LC languages, but again there appears to be variability across the group as to the rules governing it. It is not harmony of the 'cross-height' or ATR type found in many Niger-Congo languages (e.g., neighbouring Igbo), but a system whereby the vowels of affixes harmonize with the vowel of the stem. Cook (1985, 1986) has analysed the system of Efik in detail, while Kuperus (1978) has sketched that of Oro, and Kaufman (1968), Boys (1978), and Essien (1990) that of Ibibio.

To conclude this brief sketch of Lower Cross vowel systems, it may be pointed out that in none of these languages do we find contrastive nasal vowels. Cook (1985) argues for marginal phoneme status for [ĩ ẽ ã], but although these may occur in certain words without a nasal consonant as a conditioning environment (e.g., /<sup>4</sup>i/, 'yes'), I know of no cases where nasal vowels are actually in contrast with oral ones. It is interesting to note the absence of this contrast particularly in that, although vowels are generally nasalized in the environment of a nasal consonant, when this consonant disappears diachronically (see above and Chapter 5) the nasalization generally also disappears. That is, despite the existence of conditions often seen as giving rise to the development of an oral - nasal vowel contrast, such a contrast does not seem to be developing in Lower Cross.

### 2.2.2. Tone

In a great many African languages tone functions both lexically and grammatically, and the Lower Cross languages are no exception. From the lexical standpoint, the functional load of tone is not as great, for example, as is found in the tone languages of South-East Asia, though still it is not difficult to find minimal pairs for tone. Grammatically, throughout the group certain morphemes (e.g., some tenses, aspects, and persons, as well as focus and perhaps other grammatical categories) are, or may be, manifested tonally. Much of the research mentioned in this chapter has had as its primary focus analysis of the tonal system of the language in question. In particular we may point to Ward (1933) (despite certain inaccuracies), Winston (1960)<sup>23</sup>, and Welmers (1966) which, taken together with Cook's (1985) very detailed

<sup>23</sup> Winston's 'The 'mid' tone in Efik' (1960) was to my knowledge the first major analysis presenting the notion of downstep, which has subsequently become well established in contemporary phonological theory.



phonetic stretch which carries a tone" (p.18), with its minimal realization being vowel plus tone, and optional initial and final consonants. There is one tone syllable per tone. Later in the work, she uses the term 'phonetic syllable', which presumably is an alternative term for 'tone syllable'. The structural syllable is, on the other hand,

an entity which has both phonetic and grammatical significance.  
It is defined as a stretch of speech bounded by hyphen junctures  
[and] its function is to predict the phonetic value of consonants  
and vowels (p.19).

The structural syllable may coincide with the tone syllable in that its minimal shape is identical to that of the tone syllable, i.e., vowel plus tone. It more often coincides with the morpheme, in that nearly every morpheme boundary coincides with a hyphen juncture (although the converse is less often true). Possible types for Kaufman's structural syllable are V (including N, a syllabic nasal), CV<sub>1</sub>(V<sub>1/2</sub>)(C), and CV<sub>1</sub>(V<sub>2</sub>)(V<sub>1/2</sub>). (V<sub>1/2</sub>) in the first case represents an optional second vowel which may be either the same or different from the first (e.g., dúúńǝ 'search' and díók 'be bad'), and in the second, (V<sub>1/2</sub>) represents an optional third vowel which is the same as either V<sub>1</sub> or V<sub>2</sub> (e.g., dǝǝń, 'move very fast')<sup>25</sup>.

The 'hyphen juncture' postulated is one of two boundary phonemes (the other being the word boundary), and is described as having no phonetic manifestation, though its function is to "signal the phonetic value of certain vowels and consonants" (p.22). The question of whether the hyphen juncture, or a similar boundary phoneme, is necessary is taken up below.

#### 2.3.1.2. Boys (1979)

Boys (1979)<sup>26</sup>, also distinguishes two syllable types in his treatment of Ibibio, though they do not correspond to Kaufman's types. His distinction is between free and bound syllables, the latter being those which can only occur in combination with another (free) syllable. Structures typical of the bound syllable are N- (syllabic nasal) and V-, which occur only as prefixes. Free syllables occur with the structures CV, CV(V)C and CSV(C), with S referring to 'semi-vowel'. What Boys considers to be semi-vowels, Kaufman has analysed as vowels; another difference between the two is

<sup>25</sup> Kaufman's formulation may not be quite accurate; examples can be found where a third vowel is different from both V<sub>1</sub> and V<sub>2</sub>, e.g., dúái 'scold' (pl.). These are, for the most part, plural forms, and it is not clear whether the final /i/ would be considered a part of the structural syllable.

<sup>26</sup> Given that this dissertation is entirely devoted to the phonology of Ibibio, surprisingly little insight is gained into the language's consonant system and its variations, which Boys signaled as areas for future research.

their treatment of length, which Kaufman sees as sequences of vowels as opposed to Boys' view that they are lengthened vowels.

These differences aside, both Boys and Kaufman are essentially in agreement concerning possible syllable structures in *Ibibio*. Where they differ more substantially is in the syllabification of sequences of more than one syllable. For Kaufman, V is a possible syllable other than as a prefix, but not for Boys. Therefore, (1) would be syllabified differently by each (examples adapted from Kaufman; *n* represents a homorganic syllabic nasal):

1. *nímésímé ñdísímé*      'I am foolish'
- /*ń-mé-sím-é ñ-đi-sím-é*/    (for Kaufman)
- /*ń-mé-sí-mé ñ-đi-sí-mé*/    (for Boys)

### 2.3.2. Oro

For *Oro*, one of the more divergent (i.e., relative to the better known *Efik*) of Lower Cross languages, Kuperus (1978) finds essentially the same possible syllable structures, but the ambiguity in syllabification reflected in the differing solutions of Kaufman and Boys has led her to adopt the notion of 'unité syllabique', which she has taken from Barnwell (1969), who used the term 'syllable piece'. This is an entity which she describes as being (possibly) more than a syllable, but which phonological criteria oblige her to consider as a basic unit. The syllable piece may, however, coincide with the syllable, so that a CVCV sequence may be syllabified as CV-CV, i.e., two syllables and also two syllable pieces.

There are other instances of CVCV sequences in which such a division is not so clear cut, and the sequence may best be treated as a unit. In these cases, the first vowel of the sequence has the quality of one found in closed syllables (i.e., shortened and centralized), indicating that the following consonant forms the coda of the first syllable. On the other hand, Kuperus argues, there is no evidence to justify calling the final vowel of the sequence a syllable in its own right; consequently she says that the consonant also is the onset of a syllable whose nucleus is the final vowel. The consonant, therefore, is said to be ambisyllabic<sup>27</sup>, and the sequence itself constitutes one syllable piece, though two syllables.

<sup>27</sup> The concept of ambisyllabicity is now well accepted in at least certain phonological circles; cf. Kahn (1976), Clements and Keyser (1983), Fallows (1981). To the best of my knowledge the term ambisyllabic was first proposed by Welmers (1966:101-103) in his work on *Efik* (cf. Cook 1985:66), though the concept itself goes back at least to Hockett's 'interlude' (Hockett 1955: 52).



This analysis is supported by the fact that consonants in ambisyllabic position have the restricted distribution and particular realizations referred to earlier: stops (/b d k/ only) are reduced to a tap or approximant, while nasals (/m n ŋ/ only) are said to be shortened. The examples Kuperus gives to justify postulating the syllable piece are (CV-CV), /á-ká-ká/ > [ákáká] ‘he went’ (3PSg-Past-go), where the intervocalic /k/s are not weakened, as opposed to (CVCV), /sí-kí/ > [sírí] ‘remove’, where the intervocalic /k/ does reduce, to [ɾ]<sup>28</sup>. The second CVCV sequence, then, is considered to be a phonological unit, the syllable piece. That the weakening does not have to do with vowel quality is demonstrated by also comparing /á-<sup>h</sup>fáká/ > [á<sup>h</sup>fárá] ‘narrow’. Applying Kuperus’ criteria to the Ibibio example in (1), we would arrive at the following analysis in terms of the syllable piece:

## 2. /ń-mé-símé ñ-đi-símé/

The argumentation used by Kuperus is similar to that used by Cook (1985) in analysing Efik phonology; the notion of ambisyllabic consonant is used by both, and the syllable piece (or *unité syllabique*) is largely equivalent to Cook’s ‘syllabeme’. As these notions are more fully developed by Cook, they are presented below from his perspective on Efik.

### 2.3.3. Efik

#### 2.3.3.1. The Efik syllabeme

In the earliest work dealing with the sound system of a Lower Cross language, Ward’s *The Phonetic and Tonal Structure of Efik*<sup>29</sup> there is no direct discussion of syllable structure. Ward does make it apparent, though, that interesting aspects of the consonant system are related to syllable structure, specifically concerning the distribution and realization of consonants. Cook (1985) discusses this in some detail, and for him a distinction is to be recognised between phonetic and phonological syllables. That is, the CVCV sequences in the foregoing examples which contain an ambisyllabic consonant are phonological syllables (for which Cook adopts the term ‘syllabeme’), which may be divided into two phonetic syllables (or simply ‘syllables’).

<sup>28</sup> The hyphen indicates division between syllable pieces; in the examples used, this also coincides with a morpheme boundary, though this is not necessarily the case.

<sup>29</sup> Efik has a history of linguistic scholarship dating back to the middle of the last century, however, the early works of Goldie (1857) and Waddell (1849), had little to say concerning the Efik sound system. Even Ward’s work, it should be remembered, pre-dates modern phonological theory and was not intended to be a detailed phonological treatise but rather, as the title suggests and the author states, an investigation into, “the formation and distribution of the speech sounds of Efik and ... the rules governing the tone usages of the language” (p.xiii). The bulk of the work is directed towards the tonal system, and as a result has little to contribute to the present discussion.

A CVCV sequence which is clearly divisible into CV-CV (as in /á-ká-ká/ 'he went', above) is two syllables, but also two syllabemes, whereas one with an ambisyllabic consonant is two syllables but one syllabeme.

In order to distinguish between these two, Cook finds it appropriate to postulate a phonologically significant syllable juncture (Cook 1969b: 5) which he calls the 'Open Transition' (1985: 65) (or simply OT)<sup>30</sup>, which is necessary, "to be able to specify the correct organization of consonants and vowels into syllables and syllabemes" (1985: 65). The OT, then, is similar to Kaufman's hyphen juncture in that its presence is also necessary to determine the phonetic realization of adjacent consonants and vowels. The possible sequences of consonants and vowels which may comprise the syllabeme are (from Cook 1985: 75-82):

$C_1(C_2)V_1$

$C_1(C_2)V_1C_3$

$C_1(C_2)V_1C_3V_2$

Before discussing these concepts further, it is useful to examine in greater depth the Efik consonant system for, as Cook admits, "our analysis of Efik syllable structure and our establishment of the Open Transition and syllabemes as significant phonological units are dependent on the correctness of our analysis of the consonants" (1985: 84). This analysis is presented most explicitly in Cook (1969b).

#### 2.3.3.2. The Distribution of Efik Consonants and its Relation to Syllable Structure

To summarize the Efik system (adapted from Cook 1969b), there are 13 consonant phonemes, /b t d k kp f s m n ɲ j w/, all of which may occur word-initially (post-pausally), having as primary phonetic realizations [b t d k kp f s m n ɲ<sup>w</sup> j w]. As elsewhere in Lower Cross, only a restricted subset of these occur word-finally (pre-pausally), viz., /b d k m n ɲ/, which are realized as [p t k m n ɲ] respectively. Most consonants, however, are intervocalic in Efik<sup>31</sup>, and it is here that the system is particularly interesting, for there apparently must be two types of intervocalic position, as demonstrated by these examples (adapted from Cook 1969b: 4-5):

<sup>30</sup> The term is adopted from Gleason 1961: 42-43; Cook's Open Transition is different from Gleason's primarily in that it is not a prosodic element, but one located on the segmental tier.

<sup>31</sup> As elsewhere in Lower Cross, the only word initial consonants are in imperative verb forms and a handful of other words which have lost their historical prefix, or involve syllabic nasals.



3. /kíbí/ > [kíβí] 'cover' (v.)  
 /ibībènè/ > [ibībènè] 'wall'.

In /ibībènè/, the intervocalic /b/s maintain the same realization as they have post-pausally, and may be considered to be syllable-initial; in addition, the two /i/ vowels both have their open syllable realization, [i]. In /kíbí/, however, the intervocalic /b/ is normally realized as a bilabial tap [β], and the preceding vowel is realized as in a closed syllable (i.e., /i/ > [ɪ]; cf. also Efik [dí] 'come', [díp] 'hide' and [díβé] 'hide (self)'), suggesting that the intervocalic consonant must be the coda of the first syllable. Cook claims that, "The syllable division of this word is clearly not [kíβ-í], nor is it [kí-βí]" (1969 : 5). Rejecting the second alternative is justified by comparison with /ibībènè/; rejection of the first, however, Cook does not substantiate (recall that Kuperus, in her analysis of Oro, states simply that V is not a possible syllable, though V- clearly is). The intervocalic consonant, then, is considered to be ambisyllabic, for both Cook and Kuperus.

It is interesting that the only consonants that may appear in ambisyllabic position according to Cook's analysis are exactly those that occur in final position, i.e., /b d k m n ɾ/, but with a different realization. For the oral stops, this is normally a tap or fricative (according to Cook, although an approximant is more frequently realized for the velar articulation), at the corresponding place of articulation, i.e., [β ɾ ɣ~ɰ]; /k/ may also be realized as [ɾ], a uvular tap. Cook says the nasals remain unchanged, however it may be the case that these also are shortened, or otherwise weakened. This at least appears to be the case for Ibibio, where the velar nasal may become a nasal approximant (described in Chap. 3), or may even be deleted, depending on speech rate. It is also true of Oro, where according to Kuperus ambisyllabic nasals are shorter than their initial counterparts. It is worth noting that this ambisyllabic weakening may also occur across word boundaries, e.g., Efik /díβ#ébód/ > [díβébót̚] 'hide the goat'.

Given the fact of identical distribution in the two environments (final and ambisyllabic), together with the absence of a strong argument against V as a possible syllable, it is tempting to reject the notion of ambisyllabicity and state that these consonants are indeed syllable final, but with an alternate realization when followed by a vowel. There are, however, cases which more clearly militate in favour of the ambisyllabic analysis. In the phrase (from Cook 1969b: 7) *ídùké mí* 'he is not here', *dù* is the verb 'be (location)', and *ké* the negative marker (cf. *dépké*, 'don't buy'). *ké*, then, is clearly a syllable, yet this phrase is realized [ídùré́mí], with the intervocalic

/k/ being realized as a uvular tap [ɾ] rather than [k] as would be expected syllable-initially, and the preceding vowel shortened and centralized as is typical of vowels (most noticeably high vowels) in closed syllables. Given examples of this nature, there does seem to be sufficient justification for the ambisyllabic analysis.

One of the two apparent intervocalic positions may now be recognized as being the ambisyllabic one. The other is the syllabeme-initial one, but in order to account for the different distribution and realization of consonants in the two, Cook claims that the syllabeme is always preceded by an Open Transition, thereby denying that this is in fact an intervocalic position, as the OT is said to be an element on the segmental tier, and that the OT should be written into a phonological transition. The examples given in (3) would then be:

4. /-kíbí/  
     /í-bì-bènè/

with the Open Transition indicated by ‘-’.

We can now describe the distribution and realization of Efik consonants as being relative to their position in the syllabeme and their proximity to the OT; i.e., any consonant phoneme may occur initially (following an OT), whereas only the restricted set of /b d k m n ŋ/ occur elsewhere, with these latter having different realizations as presented above) depending on whether they are in ambisyllabic or syllabeme-final position.

Similar distributions have been reported for other Lower Cross languages though, as we saw, in no other case have exactly the same conclusions been reached regarding the nature of the syllable. Kaufman (1968), for example, has a hyphen juncture more or less equivalent to Cook’s OT but without having adopted the concept of ambisyllabic consonants, her structural syllable cannot be equated to the syllabeme. In order to account for the variable realization of consonants she, in part, argues that consonants in non-stem initial position are underlyingly either simple or geminate. This argument, or something similar, may hold some attraction from a diachronic perspective, but as a synchronic analysis, many problematic counter-examples are available, and moreover it would leave us with the unwanted problem of having underlying representations which never appear on the surface.

Boys (1979) utilizes neither a concept of syllable juncture nor one of ambisyllabicity; for him, ambisyllabic consonants are presumably considered to be syllable-initial, as it is stated (p.13) that only voiced consonants occur in that position. He therefore leaves unexplained the variable realizations of /b d k/. He does, however, regard “rapid realizations in word-medial position” (p.103) as an important area for further study. Different from these two, Kuperus (1978) has an analysis similar to that of Cook, though without employing a notion of syllable juncture.

### 2.3.3.3. The Open Transition and the Syllabeme.

As stated above, for Cook it is the OT that allows a distinction to be made between syllables and syllabemes, thereby determining the phonetic realization of consonants. There are instances, though, where the expected realization does not obtain, and this is one of the worrisome aspects of Cook’s analysis. That is, in certain words consonants which would otherwise appear to be in syllabeme-initial position, are realized as if they are ambisyllabic. These are usually cases of /d/ > [r], (e.g., in /ùdwà/ > [ùrùà] ‘market’), and though the number of words in which this change occurs appears to be small, and the change itself appears to be “generational or idiolectal rather than geographical” (Cook 1969b: 8, but cf. 1985: 91, where a geographical rather than a generational distribution is discussed), at least some instances of it are sufficiently well established to be recognized in Efik orthography. In cases such as these, Cook claims the OT is absent, having been lost historically (1969b), or derivationally (1985) and that therefore the consonant is actually in ambisyllabic position. A second and similar problem is seen in the two realizations of the negative morpheme ké as indicated by the examples given above, /ídùké mí/ and /dépké/, realized as [ídùré mí] and [dépké], respectively. To account for this variation, Cook would presumably argue that the OT is lost derivationally. Alternative solutions to both these problems are explored below.

Ward (1933) attempted to account for the first kind of variation noted through reference to stress. She states that initial /t, k/ do not weaken intervocally when verb root initial, and relates this to stress on the verb root, while /d/ in similar position can be weakened. So for Ward, the effect attributed by Cook to the OT is a result of stress. But we must recognize that the same weakening also applies not only to verbs and deverbal nouns, but to certain nouns in Efik which are not verbal derivatives (e.g., [ùrùà], above). Therefore, the appropriate task regarding Ward’s claim would be to explain why it is that only certain words beginning with /d/ are without stress while all others are stressed. Her argument, in fact, has deeper implications as it would suggest



that stress is a phenomenon which affects consonants and not vowels (or syllables), since the vowel following a consonant in 'stressed' position may, in certain words, be syncopated (e.g., /tʰidé/ > [trě] 'stop'). Unfortunately, Ward's discussion of stress does not go any deeper than suggesting stress is related to verb stems, and in fact, it is difficult to find any true evidence for stress, at least in the sense proposed by Ward<sup>32</sup>.

Kuperus, as mentioned, did not postulate a phonologically significant juncture phoneme though the kind of phenomena seen in Efik are also exhibited in Oro, and in other respects her analysis is similar to Cook's. For her, it is apparently sufficient to refer to initial position within the syllable piece (= syllabeme) to account for allophonic variation and at the same time distinguish boundaries of syllables and syllabemes. In other words, the notion of syllable (or syllabeme) boundary must be information given by position within the syllable, rather than being an element (segmental or otherwise) which precedes the initial position.

The belief that it is the "marginal" (i.e., peripheral) allophones that give the cues to boundaries of sequences goes back at least to Lehiste (1959) whose detailed phonetic investigation of juncture explicitly rejected the existence of independent juncture phonemes in English. The same allophonic variations that give cues to boundaries of sequences, Lehiste argues, also allow us to conclude that, "the bounded sequence constitutes a phonetically manifested higher-level unit" (1959: 62). In other words, using our present terminology, Lehiste provides evidence for the existence of the syllabeme without the need to postulate the OT as well.

Cook's reliance on the OT is in fact somewhat puzzling, in that at least originally, juncture phonemes were invoked as a means of maintaining a strict separation of levels, and this clearly is not one of Cook's concerns. Moreover, as Selkirk (1982: 355) has pointed out, "ambisyllabicity, if it exists, would provide a further argument against the boundary approach to the syllable"<sup>33</sup>.

The notion of juncture phonemes is also rejected in most current theories of phonology, but still we find structures postulated which may be seen as being more or

<sup>32</sup> This is not to assert that there is no stress at all in Efik or the other LC languages. There is likely some sort phrasal stress, and also the juncture between elements of compound words appears to be marked by stress, but these are clearly not what Ward was referring to. Faraclas (1984b) presents an analysis of Obolo incorporating phrasal stress.

<sup>33</sup> As this quotation suggests, Selkirk (1982) rejects ambisyllabicity as well as boundary phonemes. Her arguments against ambisyllabicity, however, are directed primarily towards Kahn's (1976) analysis of English, and do not necessarily translate well to the LC context. To the extent that her arguments are more universal, Hogg and McCully (1987) provide reasons why an ambisyllabic analysis may still be more attractive.

less equivalent to the syllabeme, for example, the 'foot' of metrical or dependency phonology<sup>34</sup>. Such a treatment of LC consonant phonology cannot be attempted here, however a formulation of LC syllable structure is presented below in the hierarchical terms current in phonological theory. This approach also allows us to account for those cases referred to above as problematic for the concept of the OT in a manner which does not require losing the OT diachronically or derivationally. The weakening of /d/ to [r], from this point of view, now occurs intervocalically in a straightforward and expected way, as discussed in Chapter 5; that it occurs only in a small percentage of words in Efik suggests this to be a 'sound change in progress', proceeding perhaps by means of lexical diffusion. Although research of a sociolinguistic nature has yet to be done to determine this with confidence, the suggestion is supported by Cook's assertion, cited above, concerning the generational/geographical nature of the variation in Efik. In addition, in other LC languages the change is more widespread, and in at least one dialect of Anaang, as well as in Uda, it is virtually complete. Moreover, as is discussed in later chapters, in other LC languages similar changes can be seen occurring to other consonants in this position.

The variation seen in the realization of /k/ in the negative suffix *ké* may be explainable through reference to syllable structure, for it is only when the stem to which it attaches is a light syllable, e.g., *dù*, that the initial consonant is realized ambisyllabically; if the stem is a heavy syllable, e.g., *dép*, or a complete foot, the initial /k/ is realized as a foot or syllabeme initial consonant.

It would seem, then, that phenomena explained through reliance on the notion of the OT in Cook's analysis may be adequately accounted for by other means available to current phonological theory, though without having a great overall effect on Cook's analysis, as the role of the OT would simply be transferred to consonant position within the syllabeme<sup>35</sup>. Therefore, it is apparent that the existence of the syllabeme does not depend on the existence of the OT, as this boundary phoneme is not necessary to distinguish between syllables and syllabemes. Without the concept of ambisyllabicity, however, the evidence for the syllabeme is much weaker, since if the syllabeme is indeed similar to the foot, in the absence of stress it is the ambisyllabic consonant

<sup>34</sup> Thanks to D.R. Ladd for pointing this out to me. The parallel between the foot and the syllabeme does seem to hold true at the segmental level, but as the foot is a notion usually associated with stress phenomena, it is by no means clear how it would apply in a non-stress language.

<sup>35</sup> Cook also argues that the presence or absence of the OT has implications for the tone system; in proposing to do away with the OT here, tonal phenomena have not been taken into account, but presumably these may be handled in a similar manner, i.e. through reference to foot structure.

together with (possible) evidence from the tonal system which gives the syllabeme its unity. In order to make clear that the phonological unit we are referring to here is not bounded by an Open Transition, I will use the more neutral term 'foot', rather than syllabeme.

## 2.4. Syllable Structures in Lower Cross

The basic patterns of syllable structure in all Lower Cross languages are in accordance with those outlined above for Efik, Ibibio, and Oro. That is, the following are possible syllables:

N-, V-; syllabic nasal or vowel, occurring only as prefixes.

C<sub>1</sub>(G)V<sub>1</sub>; 'G' here stands for glide. Its status is discussed below.

C<sub>1</sub>(G)V<sub>1</sub>(V<sub>1/2</sub>) C<sub>2</sub>; status of 'V<sub>1/2</sub>' as discussed above.

Given the discussion of LC vowel systems presented earlier, it is apparent that variation in syllable structure must exist across the group, particularly with regard to long or doubled vowels.

### 2.4.1. Internal Structure of LC Syllables

An appropriate analysis of LC syllable structure, given the nature of phonotactic restrictions exhibited across the group, is a hierarchical one. This follows Pike (1967), and also corresponds closely to that which is used in most current theories of phonology. That is, the syllable is seen as comprising two major constituents, an onset and a rhyme. The rhyme itself is composed of a nucleus and a coda. The only obligatory element is the nucleus itself.

Throughout LC, any consonant phoneme available to a particular language (with the minor exceptions noted earlier) may fill the onset slot, while only the restricted set of /b d k m n ŋ/ may occupy the coda. Long vowels, where they exist, indicate a branching nucleus; it is possible that the nucleus in all LC languages must be branching, in order to accommodate the diphthongs discussed above. As diphthongs and long vowels never co-occur in the same syllable (hence the notation V<sub>1</sub>/V<sub>2</sub> in the formulation above), this would be possible. An alternative would be to consider the closing element of the diphthong (this is always /j/, except for Ekit which also has /w/ as an off-glide) as the coda. (This would, of course, modify the distributional statement given above.)

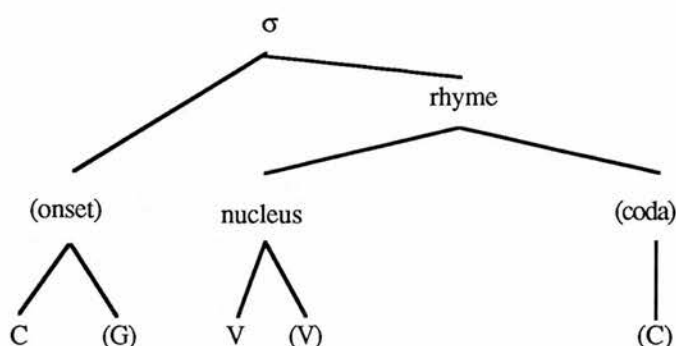


Figure 2.4a: Hierarchical nature of Lower Cross syllable structures

There are also alternative ways of representing the element labelled above as 'G'. Following the analyses of Cook and Kuperus, who consider this element to be a consonant, it would be part of the onset. The onset, too, would then be branching. Adopting the analysis of Kaufman would make this element a part of the nucleus, therefore requiring a nucleus capable of ternary branching in those languages exhibiting vowel length (or at least for Ibibio). In order to avoid this problem, I will follow the analyses of Cook and Kuperus and treat 'G' as a an element of the onset, though maintaining the symbol G, rather than C<sub>2</sub>, to make clear that it is only /j/ and /w/ which may occur in this position . A template which might serve for all LC languages, then, would be that in Figure 2.4a.

#### 2.4.2. Syllables and Feet

Given the optionality of the coda, Lower Cross languages can be seen to distinguish between light and heavy syllables, a distinction now generally recognized in literature dealing with the syllable. Briefly, a light syllable is one in which the rhyme does not branch (i.e., a simple CV sequence), while a heavy syllable has branching somewhere in the rhyme (i.e., either into nucleus and coda or within the nucleus itself). The onset is not normally considered relevant in deciding syllable weight. (See Hogg & McCully 1987, Durand 1990 for further discussion.)

While considerably more work is necessary to resolve the issue of the relation between the syllable and the foot, it seems likely that the internal structure of the syllable plays a part in the ability of concatenated syllables to be grouped into feet. We have seen examples above of light syllables together comprising a foot (e.g., Efik /dùkÉ/, Oro /síki/) but also of two light syllables remaining distinct ( i.e., forming feet individually; e.g., the CV sequences in the Oro example /ákáká/). The difference between these was a morphological one; in the latter case the rightmost element was a

lexical item in its own right, while in the former, this element was either part of a lexical item or a grammatical marker. So, although it was pointed out above that the edge of the foot does not always coincide with a morpheme boundary, it would appear that morphological, as well as phonological, information plays a role in the ability of syllables to group together into feet. On the other hand, heavy syllables, it seems, must comprise a foot independently; as we saw with the Efik example *dépké*, a following light syllable cannot join with the heavy syllable /*déb*/ as part of the same foot.

There is also variation across the group concerning the possible syllables types that may comprise a foot, but regardless, a unit equivalent to the foot seems to exist in all LC languages. The internal structure of the syllable, its relation to the foot, and the nature of the involvement of morphological information in specifying this relation, are interesting phenomena which must be left aside for future research.

## 2.5. Morphosyntactic Considerations

Before closing this chapter, a few descriptive observations on the morphosyntactic characteristics of Lower Cross languages may be useful for readers unfamiliar with the languages of the group. There has been a certain amount of work done on the morphology of some Lower Cross languages, in particular, the three focussed on in this chapter; i.e., Efik, Ibibio, and Oro. This includes articles by Simmons (1956, 1957, 1965), on verb and noun morphology in Oron and Ibibio; Winston (1970), with an interesting comparison of Efik to Bantu focussing mainly on derivational morphology; a number of articles by O.E. Essien on various facets of Ibibio morphology and syntax, including tense, aspect, mood, negation, etc. (see bibliography), and Connell (1987) on noun classification in Lower Cross. Cook (1985) contains a considerable amount of morphological information and, in addition, works by Kaufman and especially Kuperus already mentioned focus strongly on morphology, as does Urua (1990). Finally, Faraclas and Williamson (1984) have examined reduplication in Obolo. For the most part these have no strong theoretical bias, but focus mainly on description. Here, as there is obviously no room for a detailed discussion of morphology, a very brief characterization will have to suffice.

All LC languages have a basic SVO word order, which is relatively fixed, though a great many aspects of the grammar are handled morphologically. That is, categories such as tense, aspect, mood, negation, reflexivity, and reciprocity, among others, are indicated by means of affixation. And, as indicated earlier, in some



instances these are manifested entirely through alternations in the tonal system. In particular focus systems seem important and interesting; Cook (1985, n.d.) and Faraclas (1984b) discuss this for Efik and Obolo, respectively. It is not known to what extent these systems are replicated in the other languages, but given the degree of similarity that exists generally in the group, it is fair to assume similar systems are common.

Given that these languages are 'highly morphological', we expect a strong potential for diachronic work involving internal reconstruction. To date, this area remains unexplored.

## **2.6. Conclusion**

Though this chapter has focussed on similarities in the phonological systems of the Lower Cross languages, in particular among their consonant systems, it should not be taken as an indication that the differences among them are few. In Chapter Three the phonetics of the Lower Cross consonant systems are examined, beginning with a detailed examination of Ibibio. This is followed by a comparison of the phonetics of the consonant systems of other LC languages, bringing out the differences among them.

## Chapter Three

### The Phonetics of Lower Cross Consonants with Particular Reference to Ibibio

#### 3.0. Introduction

In describing the characteristics of the consonants of Lower Cross, primary focus will be on presenting those of Ibibio<sup>36</sup>. Efik will enter into the discussion to a certain extent, not so much by way of presenting new material, but because the language has been reasonably well described by Ward (1933) and Cook (1969a, b, 1985). Other Lower Cross languages will be examined only to the extent that they differ in interesting ways from Ibibio. The justification for this skewed focus is, in the first instance, the obvious reason that a work such as this must be limited in scope (it is also for this reason that detailed consideration of the vowel and tone systems is omitted). Second, the greater availability of Ibibio speakers, even while doing field work in Nigeria, made it the natural choice for major focus; this decision was confirmed by the availability of Ibibio speakers in Edinburgh, allowing for more extensive instrumental analysis of that language. It should be noted, however, that the description of Ibibio consonants offered here does not pretend to be exhaustive, especially in light of the substantial dialect variation that exists for the language. A description in (more or less) traditional articulatory terms of Ibibio consonants sets the stage for a more detailed instrumental analysis, but first a description of the methodology and instrumentation employed.

---

<sup>36</sup> Portions of the work presented in this chapter appeared in preliminary form as Connell (1987c) and Connell (1989).

### 3.1. The description and classification of consonants

The articulatory description of Ibibio consonants which follows departs somewhat from the concepts of traditional articulatory phonetics as presented, for example, in Abercrombie (1967) or Ladefoged (1982). The traditional view has as its basis (at least with regard to consonants) what is commonly known as the 'place-and-manner' system of classification, by which consonants are described according to the location and nature of the maximum linguo-palatal constriction. As Laver (*in press*) points out, though, the concept 'manner' is a complicated one, involving a variety of criteria which could be usefully separated out to give a clearer understanding of articulatory phenomena. Laver levels other criticisms at the traditional approach, but it is his suggestions concerning the reanalysis of the notion 'manner' which are of the greatest interest here.

Briefly, Laver sees segments as being classified according to four main criteria: initiation, phonation, articulation, and co-ordination. The first two of these are concepts known to traditional phonetics, however, the third and fourth represent a rearrangement of traditional concepts. The articulation component views segments in terms of 'place of articulation' (essentially as in the traditional way), 'degree of stricture', and 'aspect of articulation'. Much of what was subsumed under the concept of manner is covered by these latter two categories; other notions related to manner are, for Laver, included under 'co-ordination'.

Recognition of the importance of the degree of stricture of an articulation is of course not new. Within the traditional setting, stricture plays a key role in determining manner (e.g., stop vs fricative vs approximant), but it has also been prominent in other, less traditional, systems of phonetic classification (e.g., Williamson 1977) and phonological modelling (e.g., Griffen 1985). As Williamson points out, stricture can be considered a multivalued feature as it is a continuously varying parameter. Laver finds it convenient to describe all phonetic segments (not only consonants) in terms of three degrees of stricture: complete closure, close approximation, and open approximation, which correspond to the major segment types of stop, fricative and resonant. Within these three, segments may also be subcategorized. The segment categories correspond to a large extent to the traditional categories. However, Laver's system deviates from the traditional in that the category of resonant is not equivalent to approximant; vowels as well as approximants are included as subcategories under 'resonant' (cf. Pike 1943, Catford 1977). More important, though, is the emphasis that Laver's system places on degree of stricture, bringing it out as a major parameter

for classification.

The notion 'aspect of articulation' is also a tripartite one, in which segments are described with regard to conformational, topographical, and transitional characteristics. The first of these three, 'conformational', refers to the possible routings of the airflow: oral vs nasal and central vs lateral. 'Topographical' aspect refers to tongue shape, such as grooved or retroflex, and 'transitional' describes the motion of the tongue for articulations where there is no appreciable steady state. Different transitional aspects are flapping, tapping and trilling. From this point of view, a transitional aspect such as 'tap' may apply not only to stops as in the traditional concept of tap, but also to fricatives and approximants, and for these latter two, without implying closure, as Laver argues that speed of gesture is the main defining characteristic of 'tapped'<sup>37</sup>.

Finally, the notion of co-ordination covers timing characteristics relevant to the relation between adjacent segments (rather than those internal to segments). Affrication, often considered a manner type, as well as aspiration and phenomena commonly grouped under the rubric of coarticulation are considered aspects of co-ordination.

Although Laver retains the notion of phonetic segment (sometimes regarded as one of the more unfortunate consequences of the traditional view), he does recognize that it is not solely a phonetic concept, but one which is phonologically based as well. Despite this, his descriptive and classificational system, and the theory underlying it, more than implicitly recognize the uncertain status of the 'linear' segment. It is this fact that makes aspects of Laver's system suitable in investigating sound change; for rarely do we see evidence of entire segments changing, but rather, change is seen to occur by 'features' or parameters, some of which may be viewed as corresponding to the various categories utilized by Laver<sup>38</sup>. Examples of this are changes in degree of stricture, changes in transitional aspect, and changes in place of articulation related to co-ordination.

Therefore, I depart somewhat from the traditional view in adopting certain characteristics of Laver's descriptive system, which in itself, as Laver acknowledges, is not all that deviant from the traditional. For a more adequate understanding of sound

---

<sup>37</sup> However, EPG research presented below suggests that the degree or nature of contact is perhaps more important than duration in defining 'tap'.

<sup>38</sup> Some of these may be seen to correspond to the more traditional and better known distinctive features, but use of the term 'feature' in this context is not meant to imply distinctive features.

change, it must also be recognized that a segment-based approach is inadequate for the reasons mentioned, that such an approach misses the phonetic content of sound change.

### 3.2. Articulatory Characteristics of Ibibio Consonants

In the description of Ibibio consonants, the following values may be assumed unless otherwise qualified: all articulations described are produced on a pulmonic egressive airstream; with regard to conformational aspect, airflow is routed orally and centrally; topographically, tongue shape is neutral (i.e., convex); transitionally, articulatory gestures include a steady state. Where feasible, the description is augmented by an examination of palatograms of the different consonants (see Appendix B). For this initial description, palatograms of consonants uttered in the context [a\_a] were chosen, as it generally provided the ‘cleanest’ articulation for the consonant in question, i.e., with the quickest closure and release, and with a minimum of coarticulatory effects. The palatograms and stomatograms (sagittal drawings of the palate; these are used for articulations which exhibit a central contact) presented as illustrations reflect the maximum degree of closure and are based on a comparison of the contact pattern of eight utterances of each consonant in the specified context. The system of dynamic palatography used is that described in §3.3.1. Coarticulatory effects of vowels on consonants, as well as other articulatory characteristics revealed through use of this technique, are discussed in §3.5. Voiceless stops are unaspirated; apart from this observation, voicing characteristics are not discussed in this section other than to refer to consonants as ‘voiced’ or ‘voiceless’; these are explored in greater detail in §3.4.

#### 3.2.1. Labials

[p]: A voiceless, bilabial stop, occurs in prepausal position, where it is normally unreleased. It may also occur word internally at a morpheme boundary, but never stem initially. Examples are: [fíp-], ‘suck’, [dép-], ‘buy’, [fípé], reversive of fíp, and [àdépé], ‘you don’t buy’.

[b]: A voiced bilabial stop may occur word and foot initially, ambisyllabically in careful speech, and also occasionally in final (pre-pausal position), where it is unreleased and partially devoiced<sup>39</sup>. Examples are: [bíp-], ‘ask’, and [ábâk-], a type of soup made with palm oil, and [dép-], ‘scratch’.

<sup>39</sup> Certain suffixes in Ibibio are perhaps best described as being underspecified at an underlying level. For CV suffixes, the C normally assumes the same realization as the stem final C, while a system of vowel harmony governs the vocalic realization. Examples are: dép-pé ‘buy’+NEG, and ídíók-kó ‘bad’+NEG.



[b̥]: In ambisyllabic position, a voiced labial stop may occur which is sufficiently short that it is preferable to refer to it as a tapped stop. It is also possible for the maximum constriction achieved to be no more than close approximation, the realization then being described as a voiced labial tapped fricative. On occasion this has also been recorded as a fricated trill, involving 2-3 taps. These three realizations appear to be in free variation, or are perhaps determined by speech rate. Examples are: [ɲdoʔò] 'loneliness', 'quietness', [t̪b̥é] 'thwart', 'blunt', and [déb̥ják-] 'buy fish'.

[m]: A voiced bilabial nasal stop occurs in all positions, without substantial variation in its realization. It may be somewhat shorter in ambisyllabic position. Examples are: [má], 'like/love', [àm̩], 'I', [ídém], 'body', and [nímé], 'extinguish'.

### 3.2.2. Labiodentals

[f]: A voiceless labiodental fricative may occur only in word and foot initial position. Examples are: [áféré], 'soup', and [fámá], 'argue/disagree'.

### 3.2.3. Alveolars

[t]: This consonant occurs in word and foot initial position, and in final (pre-pausal) position, where it is normally unreleased. Examples are: [àt̪àt̪-], 'wasp', [tóp-], 'throw/shoot', and [úkôt̪-], 'in-law'. A fully articulated voiceless plosive (in that it involves substantial linguo-palatal contact), it has been described as alveolar (Boys 1979, Essien 1984), but Kaufman (1968) and Urua (1990) refer to it as dental. The reason for this discrepancy is apparent when examining the palatogram in Fig. 3.2a, which shows that the area of contact reaches from dental to post-alveolar. Although linguagrams have not been done, this large area of contact clearly indicates that it is the blade of the tongue which is the active articulator. This consonant, therefore, may be best described as a voiceless laminal denti-alveolar (or post-alveolar) stop.

EPG analysis reveals that, for the closing gesture, contact typically begins in the dental zone and anterior portion of the alveolar zone, followed by closure in the main alveolar and post-alveolar regions. There is also frequently an asymmetry to be noticed in the closing gesture, with earlier contact being attained on the right side of the alveolar ridge. The opening gesture follows the opposite pattern, with release beginning in the posterior region, and the dental zone being the last to lose contact. The release also shows the same left-to-right asymmetry as the closing gesture. Finally, the releasing gesture was seen to be slower than the closing gesture.

[d]: A voiced alveolar stop occurs in word and foot initial position, in ambisyllabic position in careful speech, and also, but rarely, in final (prepausal) position where it is unreleased and largely devoiced (this, too, may be a function of careful speech). Examples are: [d̥iòŋɔ́], 'know', [ádân], 'oil', [íkɔ́dàbàsɪ], 'Ikot Abasi', a place name (in normal running speech, the [d] would be realized as [r]), and [ùbè:ɔ́] 'room'.

This consonant has generally been described as the voiced counterpart of [t], the implication being that the two differ only with regard to voicing. However, as the palatogram in Fig. 3.2b shows, there is considerably less tongue contact for [d], and the place of articulation may be considered different. In this case, the contact area is clearly best described as being alveolar, with neither the dental nor post-alveolar regions consistently being susceptible to tongue contact. There is also substantially less, and frequently no, contact of the tongue rims, i.e., as registered on the artificial palate, although since auditorily there was no hint of a lateral routing of the air flow, it is assumed that there was contact between the rims and teeth. The precise location of contact is variable within the alveolar region, while the total area of coverage remains approximately the same. These characteristics are suggestive of an apical articulation rather than laminal. On the other hand, when complete closure is not attained at once (i.e., within the space of one EPG frame, = 10 ms), it is the sides which are closed first, and when closure is complete but weak, it is also the center which is weakest, which lead to the conclusion that this, too, is a laminal articulation.

This stop also differs from [t] with regard to its closing and opening gestures. For [t], it was observed that the closure begins in the anterior region, with contact in the posterior region attained later. For [d], complete closure is usually attained at once. There is, however, an anterior directed movement of the contact region, such that by release, the entire area of contact has generally shifted forward. This in all likelihood, implies a forward movement of the tongue, although it could also be suggestive of a change in the contact area of the tongue. Finally, the asymmetry noted above for [t] is not present for [d] except occasionally, during the release gesture. Although [d] is typically of shorter duration than [t], the nature of the closing and release gestures indicate that the reduced contact for [d] is not a case of undershoot resulting from its shorter duration. In other words, from the perspective of target theory, [t] and [d] are consonants having different targets, i.e., different places of articulation.

In terms of its articulation, then, [d] varies substantially from its voiceless

counterpart, and may be described as being lamino-alveolar. The observations that the contact area is more variable in terms of its precise location and degree of contact, even within a symmetrical vowel context, suggests it should be considered a weaker, less stable articulation than [t]. The significance of this difference is returned to in Chap. 5.

[r]: A voiced alveolar tapped stop may occur in ambisyllabic position. Examples are: [áférÉ], ‘soup’ and [údárǎ], a type of tree. In certain dialects, a tapped stop may replace [d], as described above, in foot initial position (but not post pausally), though perhaps not for all speakers nor for every word containing [d]. In most Ibibio dialects, the realization of [r] is most consistent in ambisyllabic position where a word boundary is present, e.g., [íkóràbàš], Ikot Abasi (a place name), though in these instances, in careful speech, the realization may be [d] (cf. above). In ambisyllabic position word internally, the articulatory gesture involved may be one most accurately described as a voiced alveolar approximant, e.g., [èwùrà], ‘robe’. In fact, it is frequently difficult to assign one or the other label to this articulatory gesture. As Fig. 3.2c shows, there is contact, which is audible as a tap, on the right side of the alveolar ridge. The small contact area indicates the possibility of an area of open approximation which contributes an approximant-like quality to the gesture.

The main criterion for distinguishing between [d] and [r] is said to be duration (Ladefoged 1982: 153, Laver in press); however, at least with regard to Ibibio, this is perhaps questionable. Though duration may play a role, EPG analysis also points to degree of contact/closure, which may be associated with force of articulation, as a physiological criterion. Fig. 3.2d represents typical manifestations of these, which reveal similar durations, but different degrees of linguo-palatal contact. The same may be said of [ɹ] which is also in Fig. 3.2d; it has a similar duration, but a particular linguo-palatal contact configuration. I conclude, therefore, that the primary criterion for distinguishing between [d], [r], and [ɹ], is degree of contact or stricture, which in all likelihood is related to force of articulation.

[n]: The alveolar nasal stop may occur in word and foot initial positions, ambisyllabically, and finally. Examples are: [nám], ‘influence/be intoxicated’, [ànàmà], a form of musical embellishment or harmony, [úsíénÉ] ‘compensation/payment’, and [útín] ‘sun’. It closely approximates [d] in terms of articulatory gesture and area of linguo-palatal contact (Fig. 3.2e), having the same narrow range of contact in the middle to posterior of the alveolar zone. The most notable difference is the absence of forward movement of the contact area as was

observed for [d]. This overall similarity to [d] is with regard to its occurrence intervocalically in general.

When occurring in final position, the articulation of [n] approximates that of [t] rather than [d] in that the contact area is greater (recall that [d] does not normally occur finally), however still without contact in the dental zone. The closing gesture for [n] in this position does not differ substantially from that of [n] occurring elsewhere.

[s]: A voiceless lamino-alveolar grooved fricative may occur in word and foot initial position. Examples are: [sàŋá], 'walk, move', [ísó], 'face'. In the vowel context [a\_a], the area of maximum stricture (i.e., where the groove is narrowest) is alveolar, without reaching the dental or post-alveolar zones (Fig. 3.2f). Beyond this, there must be a substantial amount of contact, with the tongue rims in contact as far back as the post-palatal region. With regard to the closing and releasing gestures, there is a tendency towards asymmetry for both, with contact on the right side of the palate being achieved earlier and released later. This asymmetry is not as pronounced as that observed for [t].

#### 3.2.4. Palatals

[j]: A voiced palatal obstruent (Fig. 3.2g) may occur in word and foot initial position, or less frequently in final position or ambisyllabically as the closing element of a diphthong. Examples are: [jém], 'want/look for', [íják-], 'fish', [wàj] 'tear/scratch' (plural). It has usually been referred to as an approximant (Essien 1984b, Urua 1990) or semi-vowel (Kaufman 1968, Boys 1979). More frequently, however, it involves a closer degree of stricture, resulting in audible friction. In word initial position or when following a syllabic nasal, [j] is frequently realized with a brief voiced palatal stop, [ɟj], as an 'on-glide'; in emphatic speech or dialectally, it may be realized as a palato-post-alveolar affricate, [dʒ], (or alveolo-palatal [dʒ̟]). In final position, as in [wàj], above, it is often realized as a full vowel: [wǎi].

[ɲ]: A voiced palatal nasal stop may occur in word and foot initial position. Examples are: [ɲàŋ], 'river', and [ɲàm], 'sell'. As may be expected for a palatal articulation, the closing and releasing gestures are markedly slower than for the alveolars. As a result, complete closure is frequently not achieved, leaving a narrow groove along the medial line as illustrated in Fig. 3.2h. The accompanying stomatogram indicates the extent of closure when it is attained in this context. Again, an asymmetry is observable for both closure and release, with contact on the right having greater duration than on the left.

### 3.2.5. Velars

[k]: A voiceless dorso-velar stop (Fig. 3.2i) may occur in word and foot initial positions and in final position, where it is normally unreleased. Examples are: [kòŋ], ‘knock’, [ákáĩ], ‘forest’, and [ébék-], ‘chin’. As indicated earlier, palatographic examination of [k] (and all velar articulations) is to be considered inconclusive in some respects, particularly in that the area of contact may extend posterior to the artificial palate. However, the EPG charts do permit the following observations to be made. In initial position, the area of contact may extend into the post-palatal or even palatal region, particularly with regard to the tongue rims. The closing and releasing gestures are slower than for the alveolars, and similar to [t], the release is slower than the closure. Similar to [d], there is a tendency for the anterior portion of the closure to be achieved subsequent to the posterior portion of the contact, although it is not clear whether the entire contact area of the tongue moves forward (Ohala 1983 cites Houde 1968 on a similar characteristic of the articulation of American English [k]). In final position it is retracted relative to its realization in initial position.

A dorso-velar consonantal gesture may also occur in ambisyllabic position. The actual realization of this gesture, whether [g], [ǰ], [ɣ], [ʁ], or [ʀ], appears primarily to be a function of vowel environment and possibly speech rate. It is not known to what extent idiolectal or dialectal factors also contribute to the variation, but a possible role for these has not been ruled out. The gesture for all of these is sufficiently retracted and/or of sufficiently open approximation that palatography provides no evidence for them except the occasional instance of contact by the tongue rims.

[ǰ]: A tapped voiced velar stop. Its occurrence appears to be restricted to contexts involving a high front vowel, for example, [ùtíǰà], ‘bow’. This articulation is auditorily sufficiently fast and light that it is appropriate to refer to it as a tapped stop. Question as to whether the tongue dorsum can in fact move quickly enough to produce a tapped articulation (cf. its declared impossibility on the 1989 IPA chart) suggests the possibility of the uvula being the active articulator, in combination with a dorsal gesture, and this indeed seems to be the case at least in some environments.

[ʀ]: A voiced uvular tapped stop occurs most clearly in the context of mid back vowels, for example [tòʀó], ‘quarrel’. It can occur in other environments, as in [údúʀíkót-], ‘snake’ (‘rope of the bush’).



[ɣ]: A voiced velar fricative is normally restricted to careful speech and vowel contexts of an open or open front quality, for example, [àḍiàɣá], ‘eldest daughter’ and [fèɣé], ‘run’.

[ɰ]: In connected speech, these articulations of [ɣ] are more likely to be realized as a voiced velar approximant, [ɰ]. As with other ambisyllabic gestures, this one too is sufficiently fast that it is often preferable to refer to it as a tapped approximant. Indeed, in conversational speech it is prone to disappearing altogether.

[ŋ]: A voiced velar nasal stop occurs finally and ambisyllabically. Examples are: [íkánŋ], ‘fire’, and [ùḍóŋó], ‘illness’. Though [ŋ] was not included as part of the systematic EPG investigation, there were a considerable number of tokens included by default, as its occurrence in the language is relatively frequent. In none of these instances is there any evidence for the articulatory gesture in the EPG record, other than the occasional rim contact. There are two possible explanations for this, and it is likely that both should be considered to play a role. In the first case, many of these tokens were in ambisyllabic position, where the articulation may actually be that of a velar nasal approximant. In other instances, including occurrences in final position, closure was clearly audible, and we conclude that the contact was sufficiently retracted that it occurred posterior to the artificial palate. (This also suggests that the closure for [k] may indeed cover a larger area than that recorded by EPG).

### 3.2.6. Labialized velars

[ŋʷ]: A voiced labialized velar nasal stop may occur in word and foot initial position. Examples are [ŋʷóŋ], ‘drink’, [áŋʷân], ‘woman’. Occasionally the velic closure is achieved before the release of the stop closure, producing a brief epenthetic [g], e.g., [ŋʷgʷ].

### 3.2.7. Labial-velars

[kp]: In descriptions of Ibibio, this stop has typically been referred to as a voiceless labial-velar stop having simultaneous labial and velar closures. It may occur in word and foot initial position, examples being [ík pá], ‘skin/covering’, [ékpê], ‘leopard’, and [kpá], ‘die’. From a phonetic standpoint, the description usually offered is inadequate; for example, there is clearly a voiced implosive release (use of the symbol [kɓ] rather than [kp] might therefore be more appropriate). A detailed consideration of this consonant, based on a number of instrumental techniques is presented in §3.6. In this section we simply describe it as being a labial-velar stop. The two closures are indeed

overlapping for the most part, but not simultaneous in a strict sense. The velar closure normally precedes the labial one, and it also seems generally to be the case that the labial release occurs subsequent to the velar release. The velar articulation of the consonant was examined through means of EPG and was found not to differ significantly from the simple voiceless velar stop [k] (see §3.5, below).

[w]: A voiced labial-velar approximant occurs in word and foot initial position and in rapid speech, post-consonantally (of initial consonants). The post-consonantal realization is perhaps more frequently [u]), and when following a voiceless consonant ([t, k], it is devoiced. Examples are: [wàk-], ‘scratch/tear’, [wɔ́k-], ‘swim’, [úwém], ‘life’, and [íkwâ], ‘knife’. On occasion, the velar stricture is noticeably closer than the labial one, sometimes to the point of a very brief closure preceding the approximant [ᵂw]. This is particularly true when there is a preceding velar nasal stop. It is tempting, therefore, to regard this as a labialized velar approximant. EPG analysis, however, indicates a substantial amount of variability in the degree of dorso-velar stricture and it is not clear that the velar constriction is always primary. I therefore prefer to see it as a labial-velar approximant.

### 3.2.8. Homorganic Nasals

I have described above the nasal consonant articulations that occur in Ibibio. With the exception of [ɲʷ], these also occur preconsonantly, where they are homorganic to the following consonant. In addition, a labiodental nasal [ɱ] occurs before [f], and a labial-velar nasal, [ŋm] occurs before [kp]. The former is in variation with [m], though it is not clear whether the source of this variation is idiolectal, or dependant on speech rate or other factors.

It is worth noting, with regard to homorganicity, that when [n] precedes [t], the articulatory gesture is initially as for intervocalic [n] (recall that the closing gesture for [n] is similar to that of [d], different to that of [t]), though homorganicity is rapidly achieved. In other words, if we consider the place of articulation at the point of maximum contact, [n] is homorganic to [t]; if, however, we also take into account the articulatory gesture used to achieve this contact, the homorganicity is seen in a different light.

## 3.3. Instrumentation and Methodology

### 3.3.1. Instrumentation

Speech material used for the instrumental analyses were gathered in both

Nigeria and Edinburgh. In Nigeria, the bulk of this material was recorded in the radio studio of the Theatre Arts Department at the University of Calabar, using a Revox A77 reel-to-reel recorder. Other recordings were done in the field, under a variety of conditions, using a Sony WMD6, a cassette recorder with high quality recording capability. On a return trip for further field work (Sept. - Oct. 1988), a Marantz CP 430 cassette recorder was used. Material recorded on cassette was generally not gathered for purposes of instrumental or quantitative analysis, but has in some instances been used for illustration.

Subjects in Nigeria (for the material collected for quantitative analysis) were in the age range 20 - 45, and included 8 men and 2 women. A wide range of informants contributed to the collection of other data, as described above in the Introduction (§0.3).

In Edinburgh, data collection and instrumental work were carried out in the Phonetics Laboratory of the Dept. of Linguistics. Two reel-to-reel recorders were used on different occasions, a Ferrograph Logic 7 and a Revox A77. Spectrography (primarily for the labial-velar analysis) was done on material collected in Nigeria and Edinburgh using the department's Kay Elemetrics Digital Sonograph 7800. Spectrograms used as illustrations in the dissertation were produced with a Kay DSP 5500 at Oxford University, and the same machine was used to verify spectrographic measurements done previously.

Aerodynamic analysis was conducted using the laboratory's Gaeltech Mark II system, which was developed in the department. This system uses an anesthetic mask divided into two separate compartments to permit separate collection and measurement of oral and nasal airflow. These are accomplished by means of a pneumotach head fitted to each compartment, capable of measuring both egressive and ingressive airflow. (Further details of this system are to be found in Anthony and Hewlett, 1984.) Charts of oral and nasal airflow, together with an Lx waveform (described below), an audio wave form, and a timing pulse were printed with a Siemens eight-channel Oscillomink Inkjet Recorder. The aerodynamic research was conducted using two native speakers of Ibibio as subjects, one man (Mr. Etuk) and one woman (Mrs. Peters). Analysis, however, has primarily been done on the results from the former, as work done with him was more extensive.

Electropalatographic research was conducted using the EPG system designed at

Reading University. This system uses an artificial palate (0.8 mm thick) made of acrylic containing 62 silver electrodes as contacts. The arrangement of electrodes on the palate used in this study is shown in Fig. 3.3a. In using this system, a low voltage current is introduced to the subject's body, with a circuit being completed whenever contact is made between the tongue and one of the electrodes. The resulting signals are sent to an electronic processing unit. The signals are then available for storage, analysis, and display using an IBM (or compatible) PC. The display takes the form of stylized charts of the artificial palate. As printed by the PC, these show the changes in tongue to palate contact over time, with each individual chart representing a frame of 10 ms (see Fig. 3.3b). Further details concerning the Reading system may be found in Hardcastle *et al* (1989).

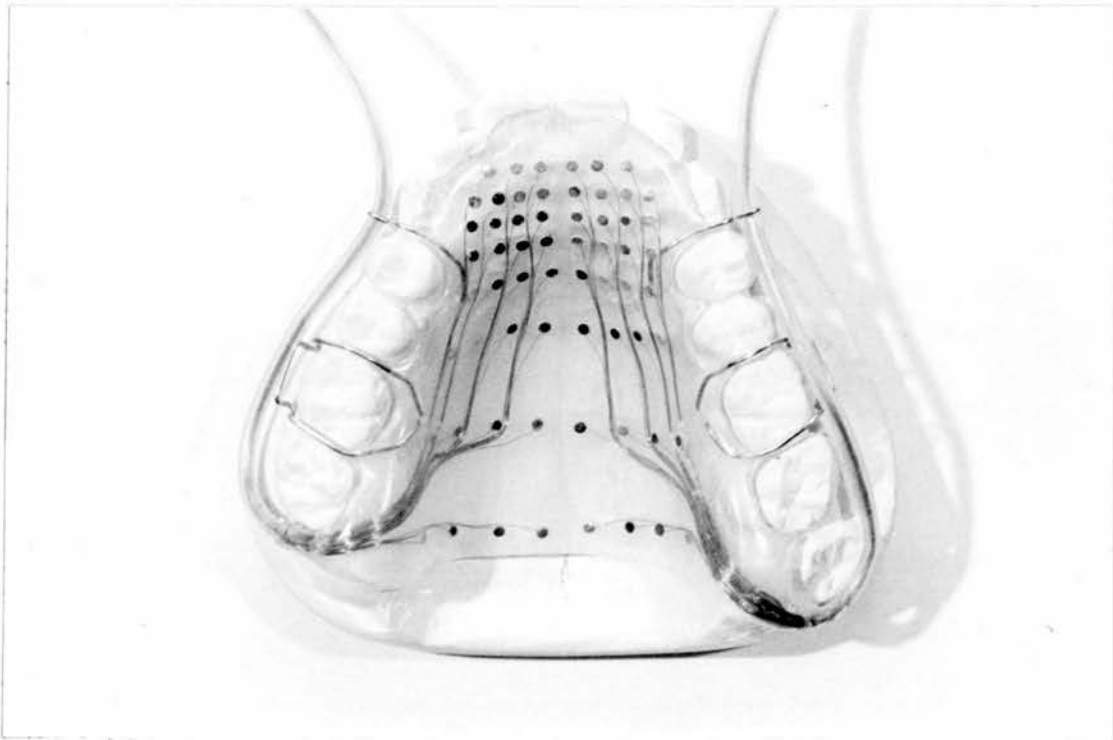


Fig. 3.3a: Arrangement of Electrodes: A reproduction of the artificial palate used, showing 62 electrodes are arranged into eight rows; the frontmost row contains six, while all others contain eight electrodes.

The system has 4 channels, allowing for simultaneous processing of different signals, e.g., EPG, audio, airflow. In this case, an audio signal was used to allow for greater ease in reading the EPG charts. A separate audio signal was recorded simultaneously, together with an Lx signal, on a Revox A77. Airflow measurement was not done at this time as it had been done previously with the same speaker (Mr. B. Etuk), who felt it would introduce too much interference to be using both the mask and the artificial palate at the same time.

There are a number of limitations to electropalatography, which must be acknowledged. The first of these concerns the use of the artificial palate itself, which may possibly hinder natural articulation. It is recognized that a certain amount of time (approximately 1 - 2 hrs) wearing the palate is required for the user to adjust to the new speaking conditions. In view of this, various researchers have adopted control procedures to ascertain whether a subject's articulation has been affected. Most common of these is to do a spectrographic analysis of identical sets of words, one recorded while wearing the palate, and one without. In the present study, a random comparison using this technique was done, without detecting any adverse influence resulting from the introduction of the artificial palate. In addition, it may be noted that auditorily there was no indication of interference from the artificial palate.

A restriction that exists for all palatography, but which is perhaps more pronounced in electropalatography must also be recognized. This has to do with the accessibility of velar and post-velar articulations to the technique. The type of artificial palate used can only extend far enough back to cover the anterior portion of the velar region before introducing discomfort. Consequently, while examination of velar articulations is possible, it may be incomplete, and analysis of results of these articulations must take this factor into account.

Another restriction which arose had to do with the software accompanying the Reading system, which to a certain extent limited the depth of analysis done by means of EPG in the present study. The software has a number of analysis routines available, which facilitate examination of various articulatory characteristics, for example vowel-consonant coarticulation. These are based on a division (specified in the software) of the rows of electrodes on the palate into three articulatory zones, in principle corresponding to alveolar, palatal and velar. Unfortunately, the placement of electrodes on the artificial palate used in this study did not correspond to the divisions written into the software, and there was no way of modifying the software; this



problem effectively rendered certain of the analysis routines useless for our purposes. The discussion of coarticulation given below, therefore, is a qualitative analysis, based on a comparison of printed EPG charts; quantitative analysis was not possible in this context.

The electrolaryngograph system, used in tandem with both the aerodynamic and EPG apparatus, was developed at University College, London (see Abberton and Fourcin 1984, and references listed there). This is an electronic impedance system which requires the superficial placement of an electrode on either side of the larynx. The output waveform (Lx) reflects variation in electrical impedance across the glottis indicative of the opening and closing action of the vocal folds. Contact between the vocal folds is necessary for the circuit to be complete, and therefore register a signal. Partial contact, rather than contact along the full length of the vocal folds, is reflected in a signal of lower amplitude. The system's limitations, then, are that it can only tell that contact is or is not occurring between the vocal folds; nothing can be learned about where along the vocal folds this contact takes place, or about glottal configuration when the vocal folds are not in contact. For more discussion on the capabilities of this system *vis á vis* similar systems and other instrumental techniques for exploring vocal fold activity, the reader is referred to Baken (1987), Hess (1983), and Hirano (1981).

When used in conjunction with the aerodynamic equipment, the Lx signal was recorded simultaneously with the oral and nasal airflow traces, an audio signal, and a timing pulse. When used with the EPG system, the Lx and an audio signal were recorded independently of, but simultaneously with, the EPG record, using separate channels of the Revox A77, one for audio and one for the Lx. A timing pulse was recorded on the same channel as the Lx, high-pass filtered at 7 kHz, while the Lx signal was low-pass filtered at 4 kHz. The audio, Lx and timing pulse were subsequently charted on the Oscillomink, with the timing pulse allowing for ready correlation of this chart with the EPG charts as printed using the PC.

### 3.3.2. Methodology

In the investigation of labial-velar stops, the primary objective was to give a straightforward description of the phonetic characteristics of these stops, particularly from the point of view of comparison with labial and velar stops. Therefore, a wordlist of 50 words (see Appendix C) was constructed using natural language data containing exemplars of labial, velar, and labial-velar stops. Further details of this investigation are presented below (§3.5).

The aerodynamic investigation was designed in part as a follow-up to the spectrographic investigation of the labial-velars. Consequently, words from that wordlist were used; however the list was reduced and incorporated modifications and additions, to permit the examination of other consonant types from this point of view. This wordlist (20 words, also in Appendix C) together with the sentences, was recorded on three separate occasions (to ensure consistency and familiarity with the apparatus on the part of the subject), with 8 repetitions of the word list and 2 repetitions of the sentences at each session. In the case of Mrs. Peters, only one session was possible. For analysis, only the results of one session were finally chosen.

For the electropalatographic investigation, the first objective was to examine consonants as they are realized in foot-initial position. The consonants [t d s n ɲ k kp] were recorded in all possible VCV combinations, using the vowels [i a u] and also controlling for tone (i.e., all VCV sequences were repeated with both high and low tones). This gave a total of 18 tokens for each consonant (9 vowel contexts x 2 tone contexts) per repetition; four repetitions were recorded. In addition, tokens of ambisyllabic consonants [ɕ, ʀ] were recorded in the same contexts. In almost all cases it was possible to find natural language data to fulfill these requirements; for the few cases where it was not possible, nonsense sequences were substituted, rather than leaving a gap. The four repetitions of the list were read in one session. In a subsequent session, a set of 15 sentences was recorded to enable a comparison between citation form utterances and those of connected speech.

The EPG and Lx/audio records were correlated in the following manner. For stops, it was usually possible to locate on the audio waveform the burst associated with release of the occlusion. By associating this with the appropriate frame on the EPG chart, and using the timing pulse, it was possible to correlate different phases of the consonant gesture with the Lx and audio records. It was soon also apparent that other features of the Lx/audio record, not only the burst, could serve as 'landmarks', which allowed for double checking in ambiguous cases, or for use when the burst was not readily apparent. Fig. 3.3b gives an example of this methodology. Further details as to methodological details may be found in the appropriate section, below.

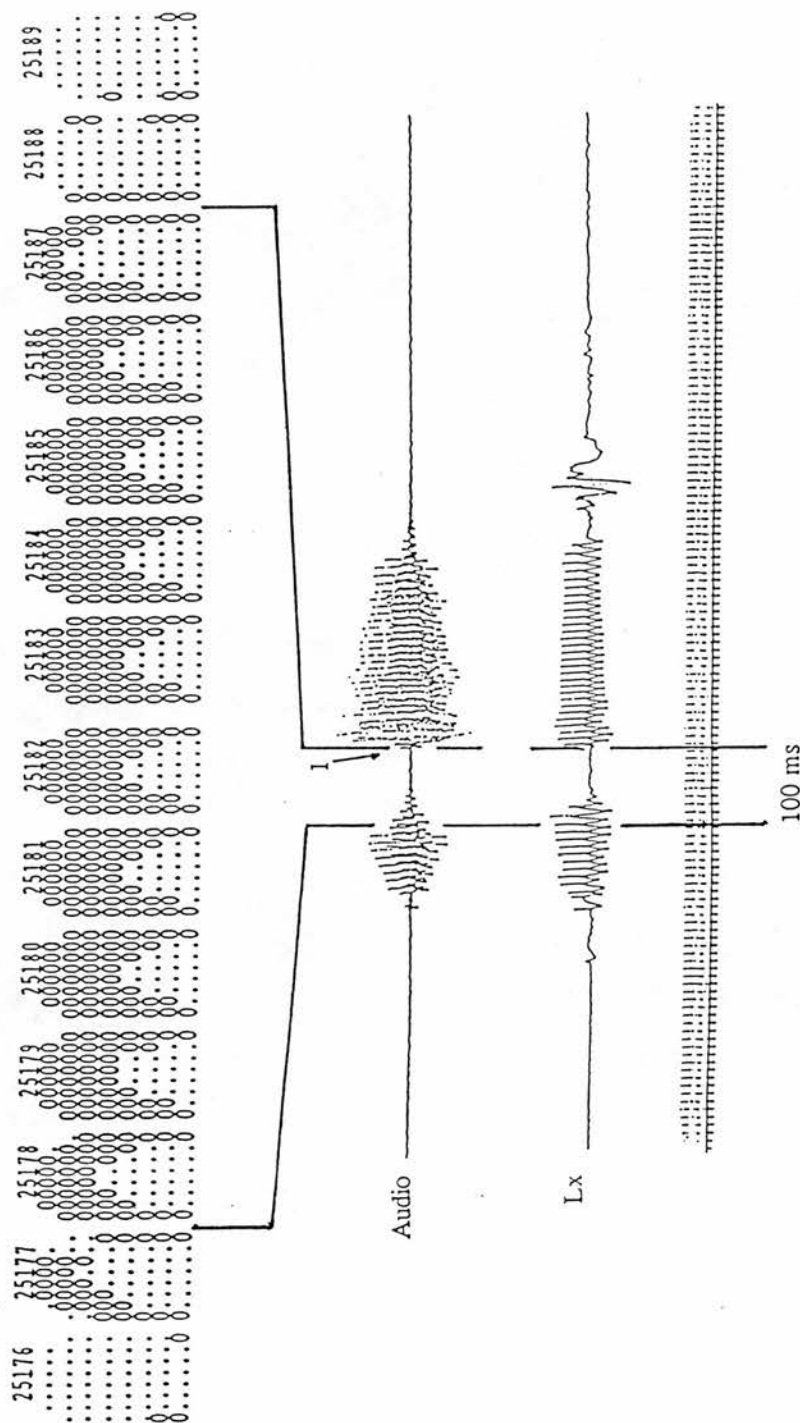


Fig. 3.3b: Correlation of EPG and Lx/Audio Charts. Lingual gestures are associated with events in the audio and Lx waveforms by first locating the release burst (1) on the audio wave form and correlating this to the release on the EPG chart. Each frame on the EPG chart and the gradations on the timing pulse represent 10 ms intervals, making it possible to associate other aspects of the lingual gesture to the audio and Lx waveforms. The utterance here is of initial [t] in [âtât] 'wasp' (Speaker: B. Etuk).

### 3.4. Voicing Characteristics

#### 3.4.1 Introduction

Although a distinction according to voicing exists in Ibibio, its role in the phonology of the language is arguably minimal. There is no contrast in voicing in final position, where oral stops are voiceless and the nasals voiced, nor in ambisyllabic position where all consonants are voiced. Word internally an opposition exists in a number of words between [b] and [p] (e.g., *díbé* 'hide' (oneself)! vs *dípe* 'lift!'), but again these two vary substantially in their articulatory gestures, with the former normally being realised as a tapped stop or fricative, and the latter as a fully articulated stop. In initial position, a voicing opposition occurs only at the alveolar place (/t/ ~ /d/), but as was pointed out in §3.2, these two also differ substantially in more ways than simply with regard to laryngeal activity. These two, the limited occurrence of a /p/ ~ /b/ opposition and the /t/ ~ /d/ opposition, then, are the only real instances of a voicing contrast in the language.

Despite the apparent relative lack of importance of voicing in the phonology of the language (or indeed perhaps because of it), it is still interesting to examine the voicing characteristics of Ibibio consonants; that is, data on voicing in a language where this feature does not play a large role in the phonology may shed light on possible voicing control mechanisms, in the same way that data from studies on pathological speech have illuminated normal speech processes. More important for our present purposes, though, is the fact that certain of the other Lower Cross languages (e.g., Ebughu, Oro, Iko, and Obolo) are undergoing what seems to be sporadic (i.e., irregular and apparently unconditioned) change with respect to voicing, and an understanding of this change may be aided by a description of voicing characteristics of the closely related Ibibio.

Most typically, studies on voicing have focussed on the differences between aspirated and unaspirated stops (e.g., studies on English and Danish). Such a distinction does not exist in Ibibio, which has fully voiced [b d] and voiceless unaspirated [p t k]. I begin, therefore, with an outline of the characteristics of these two types of stops in Ibibio. Following this, but before examining the voiceless unaspirated stops in greater detail, a sketch of current thinking on voicing control is presented. Voiceless unaspirated stops are examined with respect to voice onset time (VOT) and the nature of vocal fold activity during closure. This latter aspect is characterized primarily through reference to voice termination time (VTT - the period of time from achievement of stop closure to the cessation of vocal fold vibrations). The

term 'voicing tail' is used to characterize this phenomenon.

As indicated above in §3.3, data on voicing were collected in conjunction with other investigations. First of these was the labial-velar examination, which was intended to allow for comparison of [kp], [p], [b], and [k] through means of spectrography. Spectrograms were made of utterances from seven native speakers of Ibibio, using a list of 50 words (see Appendix C), which contained 15 tokens of [kp], 10 of [p], 11 of [b], and 12 of [k]. Utterances of an eighth speaker were discarded, as they contained too many errors and omissions.

Voicing data were also collected in conjunction with the EPG analysis, using the laryngograph. From this latter work, eight tokens each of [t], [k], [kp], [s], and [d] (among others) in nine vowel contexts, (i.e., a total of 72 tokens of each consonant) taken from one speaker were examined. Results from the two analyses are presented below, in Tables 3.4b and 3.4c, respectively. Discussion as to the comparability of the two sets of results is also included below.

#### 3.4.2. Voiced and voiceless stops in Ibibio

Stop consonants do occur in absolute initial position in Ibibio, but as indicated earlier, these are relatively rare. I therefore focus here on intervocalic initial stops. For voiced stops, both [b] and [d] may occur in this position. Typically, these are fully voiced throughout the duration of the closure; that is, not only is there no cessation of voicing, but only rarely is there any reduction in degree of contact of the vocal folds (as indicated by the Lx record). Figure 3.4a is illustrative of [d], here shown in the context [ùù] (ùùà, 'market'). In the figure, the vertical lines indicate the period of complete closure (70 ms) as correlated against the EPG charts. (The fundamental frequency of the consonant is affected by the surrounding tonal environment.)

Figure 3.4b shows voiceless unaspirated [k], in the context [íá] (íkáj, 'fire'). As in figure 3.4a, vertical lines indicate complete closure (80 ms), VTT (10 ms) and VOT (10 ms) are also marked. The voicing tail (VTT) is normally characterized by a gradual decline in amplitude of the Lx waveform. Occasionally a brief period of more or less full voicing, followed by a sharp reduction in amplitude of the Lx signal was evident. This change possibly reflects the instant of abduction, however, it was not always clearly discernible on the Lx readings, and for this reason a measurement of the duration of this part of the voicing tail has not been taken. It is discussed below from an impressionistic perspective.



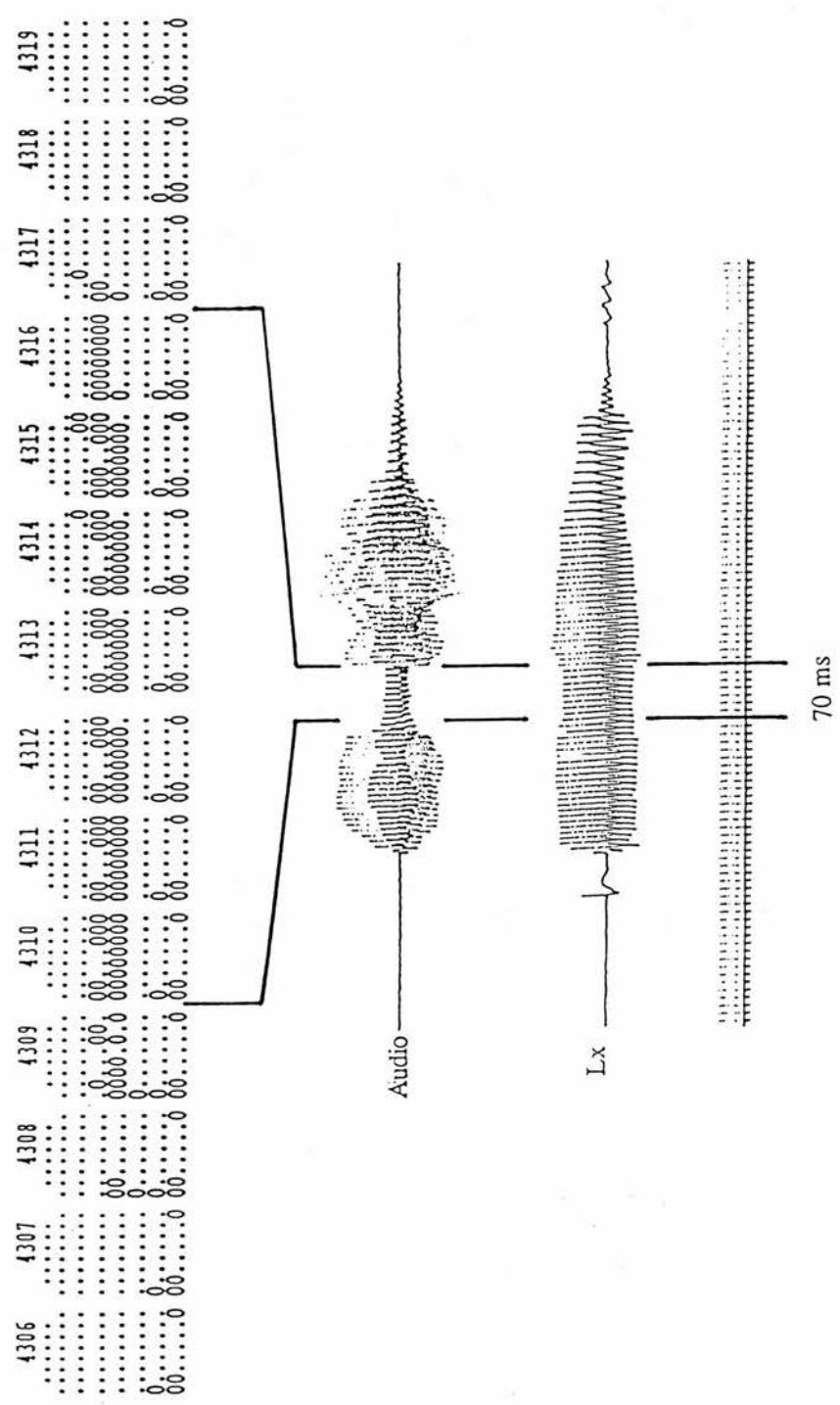


Figure 3.4a: Voicing characteristics of [d], shown in the context [ù\_ù] (ùdùà, 'market'). Duration of closure 70 ms, voicing continues throughout. (Speaker B. Etuk.)

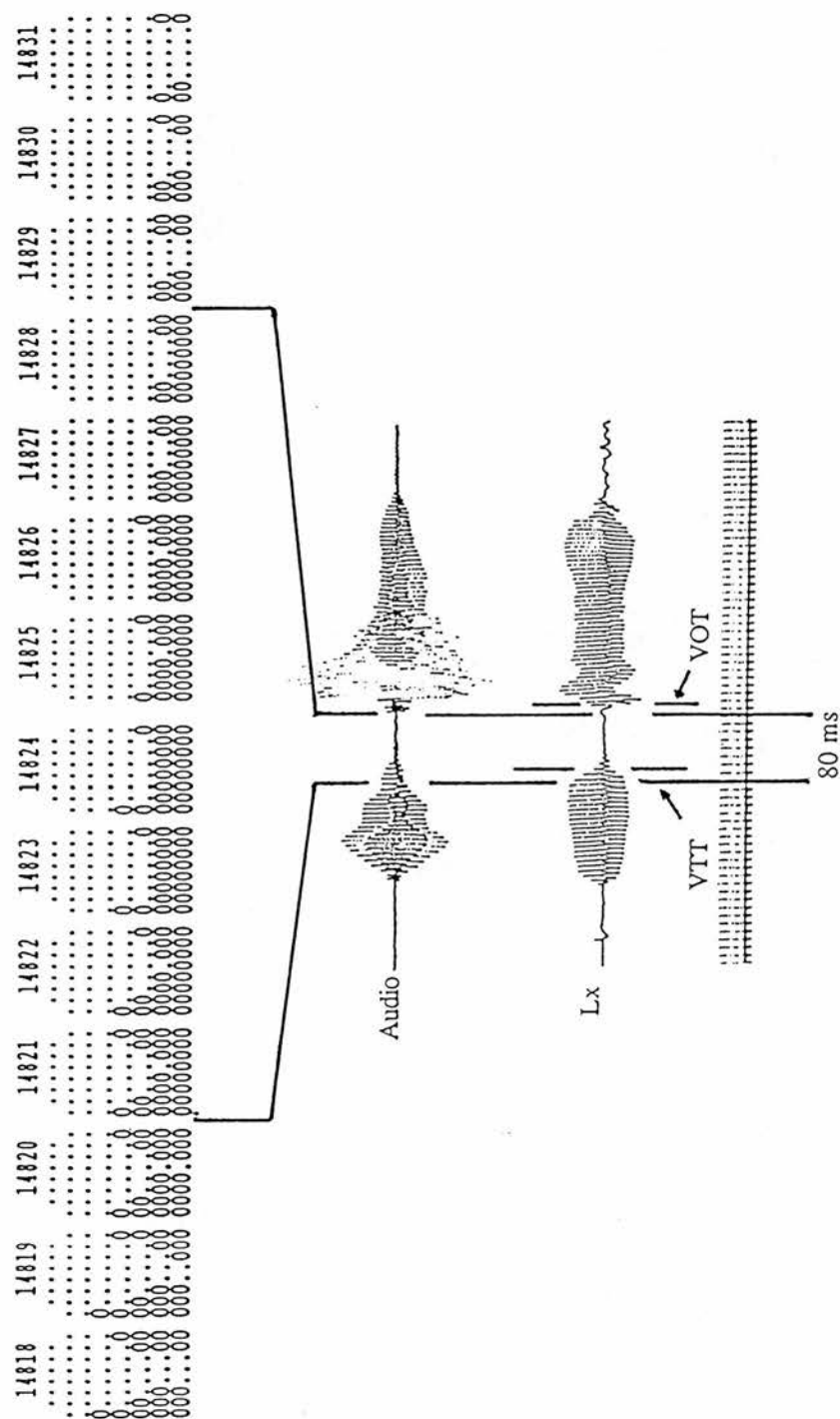


Figure 3.4b: Voicing characteristics of [k], shown in the context [lák] ('lák fire').  
Duration of closure 80 ms, VTT 10 ms, VOT 10 ms. (Speaker B. Etuk.)

### 3.4.3. Hypotheses regarding voicing control

In order to interpret the results presented below in Tables 3.4b and 3.4c in context of current thinking on voicing control, I will look first at some of the hypotheses regarding voicing. Most of this work has been concerned with the relation, or differences, between what are phonetically voiceless unaspirated and voiceless aspirated stops, and of these, focus has frequently been on stops in word initial position.

In general, two trends are discernible in the literature; one arguing that voicing control is a matter of relative timing between laryngeal and supralaryngeal articulatory gestures, and the other, that the nature of the laryngeal gesture is of greater importance.

The first of these, that of timing control, goes back at least to Lisker and Abramson (1964), who claimed that VOT is controlled by timing the onset of voicing (i.e., the adduction of the vocal folds) relative to the release of the stop closure. In the case of unaspirated stops, it was argued that the onset of voicing is timed to coincide with the stop release, while for aspirated stops, voice onset is timed to follow the release. Voiced stops are those where voice onset occurs prior to release. Control of this feature was said to be language specific, allowing for different use of the categories voiced, voiceless unaspirated, and voiceless aspirated stops in different languages.

In more recent work, Löfqvist and his colleagues (e.g., Löfqvist and Yoshioka, 1981) elaborate the view that the relative timing of the laryngeal gesture *vis à vis* the oral articulation is of prime importance, though different sizes of glottal aperture, corresponding to unaspirated and aspirated, are also reported in their work.

Using a fiberoptic / transillumination technique, Löfqvist and Yoshioka present evidence for a timing relationship between peak glottal opening and duration of obstruent closure. For voiceless aspirated stops, the interval between onset of stop closure and peak glottal opening varies according to duration of closure. They therefore contend that different timing of laryngeal and supralaryngeal gestures determines production of different stop types. For unaspirated stops, however, longer durations were obtained, but the peak glottal opening generally occurred closer to the beginning of stop closure than was the case for aspirated stops. Moreover, smaller glottal openings are reported for unaspirated stops, so that they also recognize that, "early timing of peak glottal opening together with a small opening can thus be used in producing unaspirated voiceless stops" (1981: 30). The importance of the

difference in glottal size of the two types of stops is not discussed in detail. Concerning fricatives, they also note what appears to be a correlation between duration of constriction and timing of the peak glottal opening, and that the velocity of abduction is higher than for stops, and that the peak glottal opening is wider for fricatives.

The view that it is the nature of the glottal gesture itself which is of greatest importance, was proposed by Kim (Kim 1970; see also Catford 1977). Using evidence from cineradiography of the glottis, Kim claimed that the width of glottal aperture is the determining factor of VOT. His work showed that duration of VOT correlated with width of glottal aperture; i.e., voiceless aspirated stops required a wider aperture, while voiceless unaspirated stops were produced with a narrow opening. In this view, peak glottal opening is said to coincide with the release of the constriction, and the speed of adduction is assumed to be constant. Therefore, a narrower opening would allow for a shorter voice onset time. However, there seems to be no a priori reason to assume that the speed of adduction should be constant; in fact the difference in closing times cited by Kim (100 ms for himself, 120 - 130 ms for Lieberman 1967) seems sufficiently large to question this assumption.

Hutters (1984, 1985), investigating aspirated and unaspirated stops in Danish, also favours the gesture hypothesis, rejecting the importance of the relative timing of the laryngeal and supralaryngeal gestures. Her results, based on fiberoptic and glottographic techniques and electromyography suggest that the two types of stops result from different types of laryngeal gestures. Again, in her work, it is noted that unaspirated stops have a narrower glottal opening than that employed for the production of aspirated stops, and that the gesture is of a shorter duration. Variation in timing of the laryngeal gesture with regard to duration of supralaryngeal gesture is argued to be the result of place of articulation effects.

Using data from electromyography (EMG), Hutters also explores in greater detail the question of control in unaspirated stops. At issue is whether the devoicing which occurs results from passive processes, i.e., the changing aerodynamic conditions, or if it is actively controlled. Her conclusion is that the EMG data point to active control - not of a glottal opening gesture, but as a devoicing action.

The work discussed above is representative of a growing body of research on control of voicing. It seems clear that both the relative timing of laryngeal and supralaryngeal gestures and the nature of the laryngeal gesture itself, particularly the

size of the glottis, potentially play a role in determining the categories unaspirated and aspirated in stop production. It also seems reasonable to suggest that control of the two types may involve different mechanisms; the laryngeal gesture and its timing for aspirated stops, but a devoicing gesture resulting either from aerodynamic conditions or active control for unaspirated ones. The choice of control mechanism may well prove to be language specific (or even speaker-specific), and may depend on the importance of a voicing distinction in the phonology of the language.

Apart from considerations of active control of voice timing, certain other assumptions regarding voicing appear to follow from general phonetic theory. In particular, to a certain extent it would appear that VOT and VTT may be passively controlled by aerodynamic and physiological characteristics. Research in this direction has been done by Ohala and Riordan (1979), Westbury (1983), Keating (1984b) and Westbury and Keating (1986).

It has frequently been assumed that place of articulation will have an effect on VOT. That is, other things being equal, e.g., variables ranging from vowel context to lowering of the larynx, it is assumed that fronter articulations will result in shorter VOTs, as the larger oral cavity involved would require greater time for the equalization of the transglottal pressure differential necessary for voicing to occur. Consequently, there would be a lower pressure build-up during the closure and a resulting shorter time for the necessary differential to be re-established on release, allowing voicing to begin sooner. A hierarchy  $p < t < k$  would therefore be predicted regarding VOT. This hypothesis is only apparently contradicted by evidence from languages such as Danish, which demonstrate a VOT hierarchy of  $p < k < t$ , for as is pointed by Hutters (1985: 13), Danish /t/ is of shorter duration than /k/.

A second factor, which is perhaps of greater influence, is the compliance, or elasticity, of the vocal tract walls. This would act in conjunction with place of articulation in that fronter articulations have greater surface area in their vocal tract walls, and would therefore permit greater expansion of the already bigger cavity. Ohala and Riordan (1979) calculate that voicing may continue after closure for up to 65 - 70 ms due to this effect.

It is also believed that vowel quality plays a role in determining VOT. Here, it is assumed that following high vowels will have the effect of increasing VOT, as the opening gesture takes longer, allowing for a slower venting of the built-up pressure and



therefore a longer period for the required transglottal pressure differential to be achieved (cf. Keating 1984a, Ohala 1983).

Studies on VTT in individual languages are rare, perhaps partly due to the research focus on VOT of initial stops, but also due to the assumption that VTT is phonologically irrelevant (e.g., Zue 1980: 46), and the belief that it is passive effects, rather than any sort of direct active control that are the relevant factors when considering VTT (cf. Butcher 1977). That is, contrary to Hutters' hypothesis, voicing is generally assumed to cease shortly after the achievement of stop closure due to aerodynamic considerations, rather than as a result of active devoicing control. If this is indeed the case, one might expect to find that labial and alveolar stops permit longer VTTs than velars, and that low vowels would also favour longer VTTs. These expectations follow from the existence of a larger oral cavity initially associated with these articulations, and the larger surface area of the vocal tract available for expansion to increase further the volume of the oral cavity.

On the other hand, if voicing control is a matter of interarticulatory timing, as suggested by Löfqvist and Yoshioka, then VTT presumably would also come under this control. Following their hypothesis, one would expect to find longer VTTs associated with longer stop closures and aspirated consonants if the laryngeal gesture is timed relative to the stop release. And if voicing is, as they claim, "tightly controlled" (1981: 23), then one would expect to find little variation in VTT under similar conditions. However, if voicing control is a matter of different laryngeal gestures, as postulated by Hutters or Kim, then one would not necessarily expect any correlation between VTT and stop duration. It would be reasonable in this case to speculate shorter VTTs for aspirated stops (and fricatives) as these require a wider glottis, precluding the possibility of vocal fold vibrations. Conversely, we might expect longer VTTs with unaspirated stops. Moreover, given this view of voicing control, one might expect greater passive influence on VTT for unaspirated stops, and therefore greater variation in VTT.

When mention is made of VTT in the literature, it is usually dismissed as dying off shortly after closure (Hutters 1985: 18), or as consisting of a maximum of 4 or 5 pitch periods (Butcher 1977). There have, however, been some reports of VTTs in individual languages. These are summarized in Table 3.4a, and would appear to support the claim regarding their short duration. The author of each study is given in parentheses after the language in question. In comparing these values with those

reported below for Ibibio, it should be borne in mind that the Ibibio stops are unaspirated; those of English and Swedish are aspirated, of Japanese, slightly aspirated, and Finnish unaspirated. Furthermore, in not every case have measurement criteria been presented; in none of these studies has an Lx/EPG technique been used, but where criteria have been discussed, they are similar to those used in the spectrographic study reported here. Finally, it is unfortunate that in not every case have standard deviations been reported for, as discussed below, the degree of variability found is considered important in understanding VTT and the mechanism used for voicing control.

Language	[p]	[t]	[k]
English (Keating 1984b)	13	7	6
Japanese (Keating 1984b)	10	10	5
Swedish (Keating 1984b)	16	16	8
Finnish (Suomi 1980)	13 (10)	10 (7)	2 (8)
English (Suomi 1980)	7 (9)	4 (8)	4 (10)

Table 3.4a: VTT values for different languages. Values are in milliseconds and standard deviations, where available, are included in parentheses.

#### 3.4.4. Ibibio voiceless unaspirated stops

##### 3.4.4.1. Procedure

Details of the experimental procedure used in investigating voicing in Ibibio stops has been presented in §3.3 and §3.4.2. In this section, I present the results of these investigations. Table 3.4b shows values obtained for duration (Dur) of stop closure, voice termination time (VTT), and voice onset time (VOT) for the consonants [p], [k], and [kp], as determined through spectrographic analysis. Averaged values are presented on a speaker by speaker basis for the seven speakers<sup>40</sup>, together with overall means. Table 3.4c gives values obtained for the same parameters for the consonants [t], [k], [kp], and [s], from one speaker based on the combined Lx/EPG investigation. It was decided to include [s] to permit comparison with findings obtained by Löfqvist and Yoshioka (1981) for fricatives.

Comparing values for these two tables must be done with caution, for a number of reasons. First, it should be noted that the two investigations used different speakers; that is, the speaker used for the Lx/EPG investigation was not among those

<sup>40</sup> DH's responses for [p] were eliminated as he did not give these tokens with a final vowel.

used for the spectrographic investigation<sup>41</sup>.

Second, since two different investigative techniques have been used, similar results cannot necessarily be expected. For example, in using EPG, a precise measurement of the actual period of complete closure is obtained, which is not accessible through spectrography. In the spectrographic analysis, measurements for stop duration were taken from the offset of the vowel (corresponding to the beginning of the decline of the amplitude curve), to the consonant release as indicated by the burst. As the beginning of this decline in amplitude can be assumed to precede achievement of complete closure, stop duration values in Table 3.4b can be expected to be greater than those of Table 3.4c. In the case of [kp], in the spectrographic analysis, the duration measurements presented represent the duration of the entire closure, while in the EPG analysis the duration measurement represents only the velar element closure. As is shown below (§3.6), the two articulations (labial and velar) are asynchronous, with the velar closure and release usually slightly preceding those (respectively) of the labial. Closure duration measurements for [kp] are therefore generally expected to be longer than those of either [p] or [k].

Regarding the VTT measurements, one can again expect greater accuracy from the Lx than spectrography as the intensity of the VTT signal is sometimes too low to be represented on a spectrogram (cf. Klatt 1975). However, this is not necessarily expected to translate into a finding of longer VTTs with the Lx measurements, as the measurements are, like the closure duration measurements, based on different starting points. Due to the earlier starting point for the spectrographic measurements, longer durations for VTT may therefore be expected in that analysis.

On the other hand, greater comparability can be expected between VOT measurements in the two tables (i.e., for [k], the only phone common to both). In both analyses, the starting point is the burst associated with release of the consonant closure (the EPG/Lx investigation also included an audio waveform, which, as explained in §3.3, was used in correlating the EPG and Lx signals). The onset of voicing was determined by the onset of periodic vibration (vowel onset) in the spectrographic analysis, and by the recommencement of vocal fold activity as shown by the Lx, in that investigation. Although these two events are not identical, they are

---

<sup>41</sup> Even had this speaker also been used for the spectrographic analysis, strictly speaking, his results would not have been incorporable into the overall means presented in Table 3.3.b, as the speakers in that study were recorded in Calabar, where recording conditions were considerably different from those in Edinburgh.

sufficiently close as to make no significant difference in measurements (Edwards 1981).

#### 3.4.4.2 Results

From a general perspective, the results appear to fit with those found for unaspirated stops as reported in other studies (e.g., Lisker and Abramson, 1964, etc.). In comparing [p] and [k] in Table 3.4b, we find first of all that closure duration is longer for the labial than the velar. Measurements for labial-velars have not often been reported, but, with regard to closure duration, it may be noted that the longer duration found for [kp] is at least in part due to the fact the closures are not simultaneous; discussion of characteristics of [kp] are for the most part reported in detail in §3.6.

With respect to VOT, the reverse relation obtains. Consistent with what is reported in the literature, the velar has a longer VOT than the labial. In addition, overall means ( $\bar{x}$ ) for VOT values fit with those found in other studies (cf. Lisker and Abramson 1964), though they are in fact somewhat lower. They are, for instance, considerably lower than VOTs for English /b d g/ as reported by Zue (1980: 48). Closer inspection, however, reveals greater variation than has been found in other studies (cf. Hutters 1985 for Danish and Zue 1980 for English), though the relevant statistic (i.e., the standard deviation) has frequently been left unreported.

If the values presented above in Table 3.4a can be taken as representing a normal range of VTT, then it would appear that the values shown for Ibibio in Table 3.4b are high, both with regard to means and standard deviations. Also noticeable is the variation which occurs according to place of articulation - as expected from possible passive effects, VTTs are longer for labials than for velars. In this respect the labial-velars can be expected to function as simple velars, as the velar closure generally precedes the labial one. However, even when they are simultaneous, the velar closure would be expected to dominate the labial one with regard to VTT. It is therefore reassuring to note that, while there is some variation within speakers between VTTs for [k] and [kp], the overall means are in fact quite similar.

From Table 3.4c, which reports results of the Lx/EPG analysis, we find similar values, where comparison is possible. With regard to closure duration, it is interesting to note that for the stops, closures are all of a similar duration, whereas the closure of [s] is relatively longer. The amount of variability shown in the data, however, indicates that this similarity in means should not lead to false conclusions regarding

S	Dur	VTT	VOT	N
EA	130.0 (21.9)	46.5 (35.1)	0	10
PN	59.4 (31.6)	100.0 (26.8)	2.2 (7.9)	9
DE	121.5 (15.5)	69.0 (36.6)	8.0 (6.7)	10
II	175.5 (19.5)	70.0 (40.1)	11.0 (3.1)	10
UE	129.0 (19.8)	63.0 (30.2)	8.0 (9.7)	10
DH	-	-	-	-
ME	166.5 (13.5)	48.0 (21.0)	3.5 (4.7)	10
$\bar{x}$	146.8 (29.0)	65.4 (35.7)	5.5 (7.1)	59

(i) [p]

S	Dur	VTT	VOT	N
EA	104.6 (27.1)	41.3 (27.2)	7.5 (10.3)	12
PN	110.4 (31.0)	62.5 (27.7)	25.0 (13.3)	12
DE	112.9 (26.7)	51.7 (19.2)	35.0 (6.3)	12
II	128.8 (22.6)	58.8 (39.8)	27.1 (5.8)	12
UE	114.2 (21.7)	52.5 (34.1)	17.9 (10.7)	12
DH	85.0 (14.6)	36.3 (28.1)	15.0 (8.5)	12
ME	134.6 (28.5)	37.9 (20.7)	20.8 (14.5)	12
$\bar{X}$	112.9 (28.5)	48.6 (29.4)	21.2 (13.0)	84

(ii) [k]

S	Dur	VTT	VOT	N
EA	146.0 (17.3)	31.8 (33.9)	-30.0 (18.6)	14
PN	167.3 (29.5)	77.0 (40.8)	-35.3 (10.7)	15
DE	157.5 (17.5)	50.0 (16.8)	-10.4 (15.7)	14
II	187.3 (15.5)	45.0 (54.7)	-36.7 (11.4)	15
UE	160.0 (20.3)	56.0 (32.0)	-16.3 (7.2)	15
DH	127.5 (16.5)	42.9 (13.8)	-23.0 (7.5)	14
ME	188.7 (24.9)	51.3 (35.7)	-32.3 (15.6)	15
$\bar{X}$	162.4 (28.6)	50.4 (35.9)	-26.0 (16.0)	102

(iii) [kp]

Table 3.4b: Values for (i) [p], (ii) [k], and (iii) [kp] for duration, VTT, and VOT based on spectrographic analysis. Measurements are in milliseconds, with standard deviations given in parentheses.



consistency of consonant duration across places of articulation (cf. Weismer 1980). One reason for the low closure duration reported below for [t] is that when followed by a high front vowel it is slightly affricated, and the period of affrication is not included in the duration measurements.

As mentioned, VOTs for [k] across the two tables are comparable. Here, a VOT of 19.2 ms was obtained, with a standard deviation of 12.4 ms and both of these values are close to those obtained for [k] in the spectrographic work. VOT for [t] (13.5 ms) is shorter than for [k], which again fits predictions based on consideration of possible passive effects, and again we find a relatively high standard deviation (17.7 ms). For [s], a VOT value of 15.8 ms, comparable to that for [t], was obtained, though with a slightly lower standard deviation.

	[t]	[k]	[kp]	[s]
Dur	78.0 (22.4)	74.6 (24.8)	71.5 (21.2)	90.4 (30.2)
VTT	33.4 (48.7)	29.3 (31.1)	31.8 (23.2)	5.1 (10.6)
VOT	13.5 (17.7)	19.2 (12.4)	-41.2 (15.2)	15.8 (13.7)

Table 3.4c: Values for duration, VTT, and VOT based on Lx/EPG analysis. Measurements are in milliseconds, with standard deviations given in parenthesis.

VTT values, as mentioned above, are not strictly comparable between the two tables. Due to differing measurement criteria, it was expected that VTT values from the spectrographic examination would be longer, and this is indeed the case: [k] has a mean of 48.6 ms from Table 3.4b compared to 29.3 ms in Table 3.4c, while the values for [kp] are 50.4 ms and 31.8 ms from Tables a and b, respectively. However, in both analyses, we find a high degree of variability. VTT for [t], at 33.4 ms, is slightly longer than for the velars, but it is the comparison between [t] and [s] which is most striking, with [s] having a both a low VTT (5.1 ms) and a relatively low standard deviation (10.6).

### 3.4.4.3. Discussion

The literature reviewed earlier suggested that voiceless unaspirated stops are produced with a narrowed glottis, while voiceless aspirated stops and voiceless fricatives are produced with a wide open glottis. Possible importance of the relative timing of laryngeal and superlaryngeal gestures in the latter two was also suggested. The data presented for Ibibio voiceless unaspirated consonants are consistent with the

hypothesis offered regarding the nature of the gesture. Not only the low VOT values but especially the relatively high VTT values suggest use of a narrowed glottis. On the other hand, the lower VTT found for [s] suggests a wider glottal opening, as is in fact considered necessary for the production of voiceless fricatives.

The high variability of both VTTs and VOTs in the case of voiceless stops may be taken to suggest that the relative timing of the laryngeal and supralaryngeal gestures for these stops is not tightly controlled; on the other hand, the lower degree of variation in VTT for [s] suggests that possibly the timing of the gestures involved for it is more important than that for the stops.

However, there is also a certain amount of variability in the duration of the closure in each case, and it is possible that this variability correlates with that found for VTT and/or VOT. This likelihood appears even more possible when examining the values for alveolar and velar stops in Table 3.4c, where similar closure durations co-occur with similar VOT values. Therefore, it was decided to test for a correlation between closure duration and VTT and closure duration and VOT. If the timing hypothesis as expressed by Löfqvist and Yoshioka is correct, and applicable not only to aspirated but also unaspirated stops, then a correlation would be expected between VOT and closure duration, and also possibly between VTT and closure duration. A strong correlation<sup>42</sup> in one case, but not the other, would suggest that it is that aspect (i.e., VTT = abduction or VOT = adduction) that is controlled relative to the supralaryngeal gesture rather than the other. Absence of a strong correlation may be taken to indicate that there is no tight control of the relative timing of the two gestures, with regard to abduction or adduction. This would not directly address the question of whether the peak glottal opening is timed relative to the supralaryngeal gesture, but Löfqvist and Yoshioka's work also suggests that abduction is timed according to closure duration.

Correlation coefficients for VTTs and VOTs of [t k kp s], for each of four repetitions are presented in Table 3.4d. These show plainly that there is no correlation between the duration of the supralaryngeal closure and VTT or VOT, indicating that neither of these two parameters are timed with relation to the beginning or ending of the closure. This evidence, then, together with the variability in these values discussed above, suggests that in the production of Ibibio voiceless unaspirated stops, it is the nature of the laryngeal gesture itself, rather than its timing relative to the supralaryngeal

---

<sup>42</sup> That is, either positive or negative; perfect correlation would be reflected by the values +1 or -1, respectively.

gesture, which is critical.

	VTT x Dur	VOT x Dur
[t]	0.391	-0.082
	0.357	-0.136
	0.341	-0.47
	0.127	-0.54
[k]	0.432	-0.2
	-0.062	-0.535
	0.193	-0.547
	0.43	-0.28
[kp]	0.59	0.448
	0.038	-0.3
	0.3	0.162
	0.533	-0.114
[s]	0.65	0.071
	0.387	-0.48
	0.146	-0.47
	0.319	-0.57

Table 3.4d: Correlation coefficients for VTT and VOT relative to duration of closure. Four values are given in each cell, representing the four repetitions (collapsing across tonal environment).

As this conclusion fits the hypothesis presented by Hutter regarding voiceless unaspirated stops in Danish, I return to her discussion of the postulated control mechanism of these stops. Two alternative possibilities are presented as to the nature of this control mechanism. The first of these is that it is a devoicing command which results in the abduction of the vocal folds as a consequence of aerodynamic factors in the vocal tract. In other words, the laryngeal gesture for unaspirated stops is considered to be a passive process, whereas that of aspirated stops would be an active process. However, based on her reading of the EMG evidence, Hutter suggests the possibility instead that there is a muscular-activated abduction gesture, arguing that the laryngeal gesture for both aspirated and unaspirated stops is actively controlled. This view need not deny the possibility that VTT is still largely determined by passive factors, as the abduction gesture need only be sufficiently large to curtail full voicing. When vocal fold activity (as measured by Lx) actually ceases, then, would still be determined by aerodynamic factors. The present data do not allow for thorough investigation of this phenomenon; however planned future work, using several speakers, will hopefully shed more light on the question. For the present, since impressionistically the supposed abduction appears to be subject to the same degree of variability as the parameters that were measured, it is assumed that it is not subject to

active control. It might be added, though, that if Hutter's is correct about the active control of this gesture, then it is reasonable to expect that its timing is also controlled and that timing, therefore, may be more relevant than she suggests.

If VTT and VOT in Ibibio are in large part determined by passive factors, an attempt to sort out the relative importance of these factors would be useful. As mentioned above, both place of articulation and vowel context may be expected to play a role<sup>43</sup>. From Table 3.4b, it appears that place of articulation does have an effect on both VTT and VOT. The speech material used in this investigation did not permit an analysis regarding possible effects of vowel context.

The results presented in Table 3.4c, at first, seem to present a problem with regard to place of articulation effects; VTTs and VOTs are quite similar for [t] and [k], but as was shown above, despite the similarity also found in closure duration for these, there is no correlation between this and VTT or VOT. Concerning the influence of vowel context, as mentioned above, it is assumed that for VOT any possible effect would come from the following vowel. For VTT, this is not as straightforward; both preceding and following vowel could have an influence and, similar to VOT, place of articulation would also be expected to have an effect. Analyses of variance were run on the data for [t], [k], and [s], to ascertain the significance of the effect of vowel context on VOT and VTT, and on [t] and [k] to examine for place of articulation effects.

For VOT, for each consonant, the following vowel was shown to have a significant effect. For [t], this was significant at  $p = .0038$ , for [k] at  $p = .00135$ , and for [s] at  $p = 0.0039$ . These figures may be understood in context of the means and standard deviations for VOT according to following vowel context for the three consonants, presented in Table 3.4e.

	[t]	[s]	[k]
[i]	30.2 (19.1)	22.3 (13.2)	9.2 (11.4)
[u]	8.1 (11.2)	24.6 (10.4)	26.3 (11.7)
[a]	2.9 ( 5.9)	12.2 (9.4)	10.8 (10.6)

Table 3.4e: VOT values from Lx/EPG study analysed according to following vowel context.

<sup>43</sup> The investigative technique did not permit examination of all possible influences - expansion of the oral cavity through elasticity of its walls or lowering of the larynx, for example could not be examined. Place of articulation as a factor indirectly includes the former of these two.

These results fit in, generally speaking, with the expectations that high vowels result in longer VOTs. Only for [k], though, is this the case for both high vowels, [i] and [u]. The differences between the consonants can be seen as a result of the vocal tract configurations involved in each case. For Ibibio [s] there is little change in tongue position in the sequence [si] (see §3.5 below), and if Keating (1984a) is correct in suggesting that it is the transitional gesture from consonant to vowel which is important, then a low VOT is understandable in this case.

The similarity in VOT for [t] and [k] may lie in the nature of the closures for the two - but especially that of [t]. It will be recalled (§3.2) that the articulation for [t] is best described as laminal denti-post-alveolar. Such a large area of contact would in all likelihood require the body of the tongue to be in a high position, and possibly with a convex shape - resulting in an oral cavity considerably smaller than one associated with, say, a [t] which is apical-dental. Combined with this is the EPG evidence for [k], which shows this stop to be sometimes fronted, perhaps prevelar. Given the EPG evidence, it is reasonable to surmise that the oral cavities associated with [t] and [k] may not differ a great deal in terms of their total volume, and surface area available for expansion, and would therefore have similar effects on VOT.

For VTT, for [t] and [k], the ANOVA indicates a significant effect for vowel environment, but not highly so; for the alveolar, the following vowel influence was significant at  $p = 0.0229$  while the combined influence of both preceding and following vowels was significant at  $p = 0.042$ . For [k], it was the preceding vowel which, at  $p = 0.0504$ , had the greater effect, while the combined influence of preceding and following vowels was significant at  $p = 0.0223$ . Comparing across the two consonants, the difference in place of articulation was significant at  $p = 0.0039$ . In this comparison the influence of following vowel was significant at  $p = 0.0017$ , while effects of the preceding vowel were not significant. These results indicate that place of articulation is likely the most important factor in determining VTT (see Table 3.4c); the vowel environment is important to the extent that it influences, through coarticulation, the place of articulation. The greater effect of the following vowel than the preceding confirms the findings presented below (§3.5), from the EPG analysis that Ibibio favours anticipatory coarticulation. Concerning [s], neither preceding nor following vowels showed effects on VTT that approached significance, which confirms the conclusion offered above that the laryngeal (abduction) gesture for this consonant is subject to active rather than passive control.



In summary, the facts regarding voice realization in Ibibio appear to suggest the following. First, as has been seen for other languages, voiceless unaspirated stops may well be produced with a narrowed glottis. Second, the variation in values for VTT and VOT, and the lack of significant correlation between these and values for closure duration imply that the timing relation between laryngeal and supralaryngeal gestures is not of primary importance. Rather, values for VTT and VOT would appear to be, at least to a large extent, subject to passive control. Third, the control mechanism involved would appear to be a devoicing one, rather than one specifying an opening gesture. Whether there is an actively controlled abduction gesture involved similar to what Hutters has suggested for Danish cannot be resolved by the techniques used in the present study, but this is believed to be unlikely. If, however, further research does prove this to be the case, then the vocal folds are opened sufficiently to permit devoicing to occur according to the natural limitations of the configuration of the vocal tract, whereas for [s], they must open much wider.

### **3.5. Investigations using Electropalatography**

#### **3.5.1. Introduction**

The purpose of the investigation using electropalatography was, in the first instance, to provide a descriptive account of Ibibio consonant articulations. The basis of this was presented in §3.2, where consonants were examined as they occur in the vowel context [a\_a].

In this section, I present a more detailed description of Ibibio consonant gestures, examining the occurrence of vowel/consonant coarticulation in different vowel contexts for the various consonants. The discussion is concerned first with spatial coarticulation - variations in place and degree of contact relative to vowel context - and subsequently with temporal coarticulation. The EPG data suggest answers (at least with regard to Ibibio) to the following questions:

- 1) Does the place of articulation of a given consonant vary according to vowel context?
- 2) Are there differences as to the effect of the three vowels, [i, u, a], on the nature of the closure? And if so, can a hierarchy of influence be established among the three vowels?
- 3) Assuming there are coarticulatory effects, are these governed mainly by the preceding or the following vowel?
- 4) Is there a relationship between the amount of tongue contact for a given

articulatory gesture and the degree of coarticulation?

5) Do the factors brought to light by the preceding questions vary according to place of articulation? That is, are the answers to these questions the same, for example, with regard to both alveolars and velars?

The expected answer to the first question is 'yes'. Since different vowels involve different 'places' of articulation, one might expect an influence to be seen on adjacent consonants (otherwise, it must be assumed that speech production truly is linear and segmental). With regard to question two, since adjacent consonants and vowels may be articulated with more or less the same part of the tongue (e.g. [k] and [u]), or more or less different parts of the tongue (e.g. [t] and [u]), it is reasonable to expect differences as to the degree of influence of different vowels. This expectation, however, does not immediately suggest that a hierarchy of influence among vowel contexts should also be discernible. Other researchers, as noted below, have suggested this to be the case, but it would seem mistaken to suggest that differing influence is necessarily interpretable as greater or lesser influence. In the following discussion hierarchies of influence are referred to, as determined by the various researchers; it should be noted, though, that in not every case have the criteria by which the hierarchy was established been made explicit.

Butcher and Weiher (1976), examining nonsense VCV sequences produced by German speakers, found the greatest influence to come from [i] (whether preceding or following the consonant), then from [u], and then [a]. Similar findings have been presented for Catalan by Recasens (1984a, b), though for Italian, Farnetani *et al* (1985) report somewhat contradictory results. Their study examined only tokens of [t], looking at three articulatory zones, alveolar, pre-palatal, and palatal; at least for the alveolar zone, a hierarchy of [a] > [i] > [u] is in evidence. Looking at the pre-palatal and palatal zones, however, one finds results more in accord with the other studies, and if their results are considered globally rather than broken down into zones, it appears that a hierarchy of [i] > [u], [a] would obtain (i.e., [i] stronger than both [u] and [a], but with these latter two being approximately equal in influence).

For the present study, data relevant to answering these first two questions come from examination of consonants as produced in symmetrical vowel contexts (i.e., where  $V_1 = V_2$ ). For the second question, both symmetrical and asymmetrical vowel contexts were examined.

The third question is considered to be a language specific issue, i.e., it is possible that some languages would favour carry-over (perseverative or lagging) coarticulatory effects ( $V \rightarrow C$ ), while others could show anticipatory effects ( $C \leftarrow V$ ). For German, Butcher and Weiher report both<sup>44</sup>, but with anticipatory effects apparently being stronger, while Recasens and Farnetani *et al*, for Catalan and Italian respectively, found a tendency for carry-over effects. A proper answer to this question requires examination of both spatial and temporal coarticulation characteristics; spatially, interest is in the nature of the contact pattern during occlusion (i.e., whether effects of the preceding or following vowel are in greater evidence), while temporally, two aspects potentially need to be taken into account: at what point during the closure the influence switches from preceding to following vowel, and the speed and nature of the release.

Recasens (1984a) investigated the relationship between the amount of tongue contact and the degree of coarticulation (our fourth question above) in Catalan. His finding was that there is an inverse relation between the two - greater tongue contact resulted in smaller coarticulatory effects. Recasens' conclusion is not questioned here, but it should be noted that his comparison was between dorsal (palatal and alveolo-palatal) articulations and laminal (alveolar) ones. (Recasens actually refers to alveolar [n] as being articulated with the dorsum, but this seems rather unlikely!) Given the greater mass of the tongue dorsum, it is not surprising that it shows smaller coarticulatory effects than the blade of the tongue, and it is well known that the tongue dorsum moves at a slower rate than the tongue tip (Kent and Moll, 1972); a more appropriate test of Recasens' prediction would be to examine articulations using the same part of the tongue, but involving greater and lesser degrees of contact, such as is the case with Ibibio [t] and [d].

The fifth question posed above, regarding variability across different places of articulation, will have been partially answered by the preceding one (assuming Recasens' prediction is borne out), as different places of articulation involve different degrees of tongue contact. It would still remain to be seen, though, whether the same hierarchy of contextual effects obtain, despite possibly diminished influence. Butcher and Weiher report apparent differences between the effects of coarticulation on alveolars as compared to velars, but a clear picture of these is confounded by inter-individual differences and the technical limitations of the artificial palate used in their study, which did not permit examination of the entire articulatory zone at one time. For Catalan, Recasens' report indicates that, while the degree of coarticulation varies

---

<sup>44</sup> It should be noted that Butcher and Weiher report intersubject variability regarding this question.

across different places of articulation, the hierarchy of influencing factors remains largely the same - high vowels over low ones, and preceding vowels over following ones.

### 3.5.2. Spatial Coarticulation in Symmetrical Vowel Contexts

Figures 3.5a to 3.5g (see Appendix B for these and other figures discussed in this section) present palatograms of the consonants [t d n s ɲ k kp] as uttered in the contexts [i\_i], [u\_u], and [a\_a]. The palatograms of [kp] of course give no indication of the labial closure and are presented here for comparison with the simple velar stop, [k]. It will also be recalled that the palatograms for [k] and [kp] possibly do not normally reveal the entire velar contact region for these consonants. Each palatogram is based on an examination of eight tokens of the consonant in question - four repetitions of two words for each consonant. One word in each case provided a high tone environment, and the other a low tone environment. This was done to control for possible effects of tone; there were no differences in articulation that could unambiguously be linked to tone (but more on this below), so the results were pooled. The markings on the palatograms are explained in the caption to each; in most cases the shaded area represents the area where contact was normally present at the time of maximum closure, and the dotted area the region where contact occurred some of the time. Often, representing contact area was not a straightforward matter, due to the degree of variability or movement in the place of contact (within the same vowel context); it was therefore not feasible to arrive at one consistent system for marking the palatograms.

[t] The palatograms for [iti], [utu], and [ata] (Fig. 3.5a) show variation in contact area which can be associated with vowel context. This is most apparent when considering the minimal area of contact in each case, where [iti] shows a more advanced articulation than the other two, and lesser linguo-palatal contact, while [utu] shows greatest amount of contact, though only marginally more than for [ata]. This is true only with regard to the minimal contact area; when the maximal contact area is examined, it can be seen that [iti], as well, shows greater contact area than [ata]. With regard to specifying the place of contact in each case, [iti] is denti-alveolar, and only rarely reaching into the post-alveolar region. Both [utu] and [ata] normally extend into the post-alveolar region.

Concerning variation within each context (i.e., across the eight repetitions in each case), both [iti] and [utu] showed more variability than [ata]. In fact, the variation observed for [ata] represents a difference between the two words used, [útátán] and

[àt̪àt̪], with [t̪] in the low tone environment consistently showing greater contact (the dotted area as well as the shaded, as opposed to just the shaded area). However, this is, more likely attributable to the following long vowel in [àt̪àt̪] than the tonal environment. Possible (apparent) effects of word structure as a cause of variation are discussed below. Certainly, then, there are differences in contact area (question 1 above) in the three cases, but these turn out to be minimal when the entire range of contact for each is considered. And while the differences that do exist can be described by reference to variation in place of articulation (i.e., denti-alveolar vs denti-post-alveolar) it is not clear that this should be seen as a change in place, rather than simply greater or lesser contact at the same place, resulting from varying degrees of influence of the three vowel contexts.

Regarding question 2, it seems to be clear that the different vocalic contexts do indeed exert different degrees of influence on the consonant articulation; how to establish a hierarchy of influence, however, presents problems. In the high front vowel environment, [t̪] is advanced; in both high vowel environments, it demonstrates greater contact, which can be associated with the raising of the tongue body for the production of these vowels; but how then does one account for the large contact area associated with the low vowel - as a coarticulatory influence of the vowel, or as resulting from an absence of influence from the vowel (i.e., as the consonant at its most 'natural' or 'uninhibited')? If the latter approach is taken, then it would appear that coarticulatory effects on [t̪] generally, are minimal. However, it would also be possible to argue that a higher degree of within context variation can be taken as a reflection of greater coarticulatory influence. This would follow from theories of articulation dating back at least to Öhman (1966), who argues that consonants and vowels result from separate but overlapping sets of neural commands. The greater variation for [iti] could therefore be seen as reflecting the competition between the two sets of commands. Since the articulation of [a] involves a substantially different part of the tongue than that of [t̪], there would be less competition between consonant and vowel commands, therefore accounting for the smaller variation seen in [ata]. For [t̪], then, this suggests an influence hierarchy of [i] > [u] > [a], though the differences between the three vowel contexts is in this case minimal.

[d] and [n] As the articulatory gestures for [d] and [n] are quite similar, the effects of coarticulation on these two consonants can be discussed together. In examining the palatograms (Figs. 3.5b and 3.5c), it should be borne in mind that these represent far more variation (i.e., within a given vowel context) than was present for [t̪]. For [d]



and [n], the dotted area together with the shaded area represents the total possible range of contact area; the shaded area alone represents the usual, or what may be considered an average, contact area. That is, contact throughout the shaded area may not have been present on a given repetition, but normally was. It should also be noted that these consonants had very little steady state during the period of maximum contact. One difference that does exist between the two is that [n] normally shows greater contact than [d], though it may be pointed out that this is still within the possible range of contact for [d].

Having taken these factors into consideration, it can be seen that the articulation of these two consonants is influenced by their vowel context, in fact to a greater extent than [t]. The [i] context has the effect of advancing the articulatory gesture, as is indicated by the consistent contact in the dental region, which is almost as consistently absent in the other two vowel contexts. Of these only [unu] shows occasional dental contact, while [ada], [udu], and [ana] never do. The contact area in the [a] context is the most retracted of the three, and again, as was seen in the case of [t], the [i] and [u] contexts show greater possible contact than [a], reflecting the raised position of the tongue body.

With regard to variation within vowel contexts, the [a] context again showed somewhat less variation than the two high vowel contexts, but in this case, greater variation was seen in the [u] context than in the [i] context, particularly for [n].

[s] It is apparent from the three palatograms for [s] (Fig. 3.5d) that this is, like [t], a relatively stable articulation. At least with regard to contact at the time of maximum constriction, there is very little variation to be seen across the three vowel contexts. What differences are in evidence, however, can be attributed to contextual influence; i.e., [isi] shows slightly more contact along the tongue rims, and [usu] slightly more contact involving the dorsal part of the tongue. As is shown below, there is greater variation with [s] when temporal coarticulation is taken into consideration.

Similar to [t] in its apparent stability across vowel contexts, [s] is also relatively stable within vowel contexts and based on this metric, like [t], showed a coarticulation hierarchy of [i] > [u] > [a].

[ɲ] The palatal nasal [ɲ], as is shown in Fig. 3.5e, frequently did not involve complete contact. It appears to be (and frequently sounds like) a nasalized palatal

approximant. (The palatal approximant [j] was not included as a systematic part of the EPG study, however comparison may be made with Fig. 3.2g, above, which shows [j] extracted from the sequence [ija].) Again, some coarticulatory influence is to be seen, as both [i] and [u] contexts show greater linguo-palatal contact than the [a] context. This tendency is also reflected (admittedly marginally) in the number of tokens where complete closure was achieved; for both [i] and [u] contexts, complete closure was attained on 4 out of 8 tokens, while for the [a] context, this occurred in only 3 tokens. That is, it is probable that the higher rate of complete closure for [i] and [u] contexts is a result of the overall higher position of the tongue body for these vowels. However, for the [i] context this also correlated with the words used. In addition to the existence of variation in degree of contact, [ɲ] also shows some variation in place of articulation, which follows the pattern of a more advanced articulation for the [i] environment, and more retracted one for [a].

Distinguishing differences in within context variation for [ɲ] was a more difficult problem than for the preceding consonants. This sort of variation does indeed exist for [ɲ] more than for [t] or [s], but less than for [d] or [n], however it was not clear, on an impressionistic basis, which context was showing greater variation. A potential compounding factor was the inclusion of two nonsense sequences in this set, [ɲiɲ] and [uɲu], which tended to have more stable articulations than those using natural language data (though this effect could equally be a result of the high vowel context).

[k] As the artificial palatal does not cover the entire potential contact area for velar articulations (Fig 3.5f), observations cannot be made concerning variation in degree of contact according to vowel context; that is, it is not known to what extent contact occurred posterior to the palate, and how this varied. There is, though, clearly a fronting of the gesture in the [i] context, to such an extent that this could be considered a palatal stop, [c]. Although [iki] is not as advanced as [ɲiɲ], it is in the same area as [apa], but also having the back of the tongue raised and in contact. This indicates in a rather vivid manner the coarticulatory nature of the fronted [k], that it has also retained, to a certain extent, its velar place of articulation. On the other hand, both [uku] and [aka] remain entirely velar articulations. In comparing the [i] context with the other two, it must be borne in mind that the area between rows of electrodes at the posterior end of the palate is quite wide (see Fig. 3.3a), such that the forward range of the [u] and [a] gestures is more of an estimate than was the case for the other consonants examined; they could, in actuality, have been slightly more retracted or advanced than what is indicated. Two palatograms have been included for [iki]; both reflect the

fronting of this consonant, but also show different degrees of linguo-palatal contact. Once again, the difference appears to be a function of word structure, and will be discussed below.

[kp] Palatograms of the velar closure in [kp] are also included in this section (Fig. 3.5g). One would not necessarily expect to find any substantial difference between these and those of the simple velar stop. If, as Ladefoged (1964: 10) suggested, the double stop in *Ibibio* is made with a velaric airstream mechanism (and therefore presumably involving a backward motion of the tongue at the point of velar contact), differences would be expected to manifest themselves more on the temporal plane, rather than on palatograms showing the extent of closure at the point of maximum contact. And, it does appear to be the case that the differences that exist are minor. The most striking variation is in the articulation of [ukpu], which is, at least in its possible contact range, more advanced than its simple counterpart, [uku]. This does not appear to be related to the words used, as there was one token of each which exhibited the fronting. On the other hand, the difference between [aka] and [akpa], i.e., the apparent weaker contact for [akpa], does seem related to word structure and is returned to below, with other cases of this type.

### 3.5.3. Summary of spatial coarticulation (symmetrical vowel contexts)

To summarize the observations thus far, there is no question that specific vowel contexts exert different influences on the consonantal gesture. Variation in place of articulation has been noted, though in the case of [t], it appeared that this variation was the result of greater contact rather than an actual shift in location. On the other hand, both [d] and [n] demonstrate what could be termed a change in place of articulation. With regard to [k], the contact area was seen to be strongly advanced (palatalized) in the high front vowel environment, but still retained its velar (or pre-velar) contact. Because of the limitations in examining velar articulations, it cannot be discerned whether the entire contact area had shifted forward of the true velar region, though this would seem to be a plausible assumption.

Establishing a hierarchy among the three vowels as to which exerts greater influence does not appear to be a straightforward matter - both [i] and [u] give the expected effects of (at least potentially) bringing about greater tongue contact and advancing or retracting of the contact area in most instances. On the other hand, [a] contexts often involve more contact and greater retraction than might have been expected for a low front vowel. It is possible to argue, then, that the [a] context is

actually not exerting a great deal of influence on the consonants. The possibility of using the degree of variability found within a given vowel context was advanced above as a possible measure of coarticulatory influence, with greater variability in the consonant gesture indicating greater influence from the vowel context.

The question of whether there is a relation between amount of tongue contact and amount of coarticulation (question 4) can be given a provisional answer through examination of [t], [d], [n], and [s], all of which involve alveolar articulations. It was seen that [t] and [s] varied the least across vowel contexts, whereas [d] and [n], which involve substantially less tongue contact, show the greatest amount of coarticulation. It would seem then, that for Ibibio alveolars, Recasens' prediction of an inverse relation between amount of tongue contact and coarticulation is borne out.

Finally, there does appear to be some variation in coarticulatory effects across places of articulation, especially with regard to Recasens' prediction. Both [t] and [s] were seen to be relatively stable, and the same can be said to be true, though to a lesser extent, of [ɲ]. On the other hand the velars, which also involve substantial contact, showed themselves to be quite susceptible to fronting in the [i] context. This observation was, in fact, not unexpected, given the gross movement of the tongue body required for the production of [i] relative to [k].

#### 3.5.4. Interlude: possible effects of word structure

It was noted on a number of occasions in the preceding discussion that there appeared to be a relation between consonant realization and the word the consonant appeared in. In the case of [t], somewhat greater contact was observed when that consonant was followed by a long vowel; it is also the case that the duration of complete closure (see below) was longer in this environment. These observations run contrary to conventional wisdom, which would suggest shortening of consonants when followed by a long vowel, however it is interesting to note that Stewart (1989) has postulated similar phenomena - the co-occurrence of long consonants and long vowels - for Proto-Bantu. Nor are other cases of observed variation straightforwardly interpretable, though some appear to be related to the phonological structure of the word. Particularly interesting in this respect is /àɲàɲâ/. The discussion above of tokens of [ɲ] from this word are based entirely on the second occurrence of the consonant. The first, while phonologically /ɲ/, was consistently realized as [j], suggesting this to be a weaker position in the phonological structure of the word (note that this position does not correspond to ambisyllabic position, as defined in chapter 2).

While this was the most clear cut case, the same phenomenon is observed with the variation in /ikikè:/, where the second consonant consistently exhibited a stronger articulation. That this weakening does not only occur to the first of two like consonants is demonstrated by /ákpátádá/, where /kp/, in a similar position in the word, was also realized with a weaker articulation than /kp/ in /àkpàdà/. It seems plausible that this phenomenon may be related to stress in Ibibio, an area of Ibibio phonology which to date remains unstudied.

### 3.5.5. Spatial coarticulation in asymmetrical vowel contexts

The most interesting question with regard to coarticulation in asymmetrical vowel contexts is the third one above - whether the preceding or following vowel exerts greater influence on the consonant gesture. One way of examining this is to compare the contact patterns at the period of maximum contact for reversed vowel contexts (e.g., [i\_a] vs [a\_i]), to see which of the symmetrical environments they resemble most closely. Figures 3.5h - 3.5k show the contact patterns for the six asymmetrical vowel contexts which were part of the experiment: [i\_a], [a\_i], [i\_u], [u\_i], [u\_a], and [a\_u] for [t], [d], [ɲ] and [k]. These consonants are chosen as representative, and examination of them is sufficient to establish the trends that exist.

A general statement may be made initially to the effect that, overall, the following vowel, regardless of its quality, appears to dominate the configuration of the contact at its maximum. This does not occur without influence from the preceding vowel, which in certain cases does seem to be the stronger. There also appears to be certain variation across places of articulation with regard to directionality of influence.

[t] Both directions of influence can be seen in the various palatograms for [t] (Fig. 3.5h). Comparing [ita] with [ati], it can be seen that the contact pattern for [ati] resembles that of [iti] more closely than does that of [ita], which in turn more closely resembles that of [ata]. On the other hand, carry-over effects of [i] are also observable in [ita] when it is compared to [ata], in that there is greater contact along the sides of the palate. Similarly for [uti] and [itu], comparison with palatograms of corresponding symmetrical environments reveals the dominant influence of the following vowel.

Comparing [uta] and [atu], the latter shows slightly greater contact suggesting, again, influence from the following vowel in the form of the raised tongue body. This is confirmed by comparison of these with [ata] and [utu], where [atu] and [utu] show little difference in contact, but [atu] shows greater contact than [ata], just as [uta]



shows less contact than [utu]. Some influence from the preceding vowel may be evident for [uta], which demonstrates greater contact than [ata].

[d] Specific tendencies are not as readily discernible for [d] (Fig. 3.5i). Both [ida] and [adi] bear closer resemblance to [idi] (especially in that dental contact is possible), indicating a carry-over effect in the former and an anticipatory effect in the latter. Alternatively, this suggests a dominance of [i] over [a], rather than a directional influence, a possibility which is also supported by the observation that there is a greater tendency for post-alveolar contact from a following [i]. The effect of [a], however, is not entirely absent as in both cases the contact is also more retracted than what is found for [idi].

Again, for [idu] and [udi] there appears to be a dominance effect, rather than a directional one, in that dental contact is possible in both cases, whereas it was not for [udu]. The contact is also more advanced generally in these articulations, though the influence of [u] is also evident in that more substantial contact obtains for these two than for [idi].

Comparing [uda] with [adu], the picture is slightly clearer. That is there is greater evidence for directional influences, with the following back vowel of [adu] effecting a more retracted contact. This anticipatory influence can also be seen by comparing [uda] with [udu], with the latter showing a larger contact area, reflecting the height of the following vowel. Possible influence of the preceding vowel can be found comparing [uda] with [ada], as [uda] involves more contact along the sides of the palate, again reflecting the height of the vowel.

It is also interesting to remark that with [d], tokens involving [i] as the following vowel generally showed greater variation than those having [u] or [a] in V<sub>2</sub> position. And finally for [d], it should be noted that the EPG charts often showed no lateral contact. In these cases, since these tokens did not sound to be laterals, it is assumed that there in fact was closure, but it was against the teeth or gums, out of the range of the electrodes on the artificial palate.

[p] Comparing [ipa] and [api] (Fig. 3.5j), the contact is retracted in the former, while in the latter it is not only more advanced, but also more substantial; both of these observations are consistent with influence from the following vowel, and [ipa] can be seen to resemble [apa], while [api] resembles [ipi]. Similarly, [ipu] shows a retracted

articulation, while for [upi] the contact area is, again, not only advanced, but also relatively large (compare [api] and [upi]), reflecting the effect of both vowels being high. Comparing [ipu] and [upi] with the respective symmetrical environments serves to confirm this tendency to greater influence from the following vowel.

Looking at [upa] and [apu], there is little to suggest a more prominent direction of influence, as both involve substantial contact areas. Rather, this comparison suggests that [u] exerts a greater influence than [a]. This conclusion is confirmed by comparing these two with [apa] and [upu], where it can be seen that both resemble [upu] more closely.

[k] The greater influence of the following vowel on sequences involving [k] (Fig. 3.5k) is apparent in comparing palatograms for [ika] and [aki], where the latter has a more advanced contact, and the same is true of [iku] and [uki] when one takes into account the dotted area, though less noticeably so. Comparing these four with palatograms of [k] in symmetrical environments, the effect of the preceding vowel also becomes apparent, as both [iku] and [ika] are more advanced than [uku] and [aka], respectively, while both [uki] and [aki] are retracted relative to [iki].

There is little difference between contact patterns for [aku] and [uka]. However, the tendency for [u] to dominate [a], regardless of sequencing, also shows up with [k], in that all contexts involving the back vowel have a more retracted articulation (at least potentially) than [aka].

### 3.5.6. Summary

To summarize thus far, Ibibio appears to have a preference for anticipatory coarticulatory effects. However, to state that Ibibio is an 'anticipating' language would be an over-simplification, as both carry-over effects and the varying influences of the different vowels also play a role. The prominence of one type of influence over the others appears related to the consonant in question. Anticipatory coarticulation predominates for [t] in all vowel contexts. For [d], this was true only of [u\_a] and [a\_u], otherwise [i] appeared to dominate both [a] and [u] (but the former to a much greater extent). For [ɲ] the reverse was true, that anticipatory effects were present for all contexts but [u\_a], and [a\_u]. For these two contexts it appeared that [u] held sway over [a]. The same situation obtained for [k] as for [ɲ], that anticipatory influences were stronger except in cases involving both [u] and [a]. In these instances [u] again appeared to dominate. Ibibio, then, appears to have a tendency for anticipatory

coarticulation, which is over-ridden when the vowels in question are articulated with (more or less) the same part of the tongue as is used for the consonant gesture. In other words, whereas Recasens (1984a) argues that vowel height is apparently the determining factor in degree of influence, data presented here suggests that the capacity for influence is not inherent to the vowel itself, but is a function of the relation between the vowel and consonant in question.

### 3.5.7. Dynamic aspects of coarticulation

It is well recognized that the major advantage of electropalatography over older palatographic techniques is that it allows monitoring of linguo-palatal contact over time. Since, in addition to spatial considerations, temporal factors also shed light on the issue of coarticulation, EPG is a valuable tool for examining this phenomenon. In this section, various dynamic aspects of consonant articulation in Ibibio are presented and discussed. For this purpose, the articulatory gesture has been divided into three phases: the closing gesture, the period of complete (or maximum) closure, and the opening gesture.

The closing gesture was taken to begin with the end of the steady-state of  $V_1$ , and to end with the achievement of complete (or maximum) closure. Note, however, that in many cases (most noticeably for [d] and [n]), tongue movement resulting in greater contact occurred after the attainment of complete closure. The period of complete closure was measured from the beginning of closure as indicated by activation of one complete row of electrodes, or the overlapping of contact (electrode activation) in two adjacent rows of electrodes. For [s], the period of maximum constriction was considered; i.e., when the constriction had reached its greatest extent in any one row of electrodes. The same principle was applied to [ɲ], and other cases where complete closure was frequently not achieved. This phase of the articulation was considered complete with the breaking of complete closure (or maximum constriction) and movement towards the posture for  $V_2$ . The opening gesture was taken to begin at this point, and was considered complete when the steady state for  $V_2$  was achieved, as indicated by an unchanged contact configuration of at least 30 ms in duration.

Just as movement towards greater contact was observable after closure had been reached, so too was movement towards lesser contact before release of complete closure was in evidence. That is, the closing and opening gestures, in effect, overlap with the period of complete closure. This overlap was not taken into account in doing the measurements for two reasons: first, the criteria for measurement as just set out

appear to give the most relevant information - i.e., what is of interest is the rate of transition to and from the constriction, as conditioned by differing vowel contexts, as well as variation in duration of closure.

With regard to the potential for sound change in particular, what is of greatest interest is the contact configuration at release, and the nature of the release, as it is these factors which presumably have the most effect on the perception of the consonant in question<sup>45</sup>. Concerning vowel to vowel coarticulation, it would have been of interest to measure the tongue movement in its entirety for the closing and opening gestures; this, however, presented innumerable problems in determining precisely where the change-over from a closing to opening movement occurred. This aspect is therefore discussed below from a qualitative, rather than quantitative, perspective. Results and discussion of these measurements are presented below, together with a description of the articulatory gesture illustrated with EPG charts. As above, this is done first for consonants in symmetrical environments, on a consonant-by-consonant basis, then for asymmetrical environments.

### 3.5.8. Temporal coarticulation (symmetrical environments)

[t] In the environment [i.i], the articulation of [t] evolves relatively slowly (see Fig. 3.5l). Contact proceeds from that involved for the vowel along the sides of the palate to the anterior region of the palate, where closure is first achieved in the dental region. Contact in the alveolar zone is attained subsequently. As Fig. 3.5l reveals, there is also a certain amount of asymmetry to the gesture, particularly in closing. The release of closure, initially, is quicker than the closing gesture, with center contact being broken first, resulting in a contact pattern similar to that found in the production of [s] (see Figs. 3.5.u-w, below). The movement then more slowly settles into the steady-state for the vowel [i]. Measurements are found in Table 3.5a.

For [utu], both the closing and opening gestures are quicker than for [iti], with the major portion of the contact in the dental and alveolar zones being achieved at once, and the peripheral (post-alveolar) areas being contacted subsequently (Fig. 3.5m). The opening gesture again occurs first in the central region, involving a brief passage through a palatal configuration. This is not the case for [ata], which as Table 3.5a shows, has the quickest rates of transition of the three environments. Again for the closing gesture, contact in the central region is achieved earlier (Fig 3.5n), though the

---

<sup>45</sup> This assertion assumes, of course, that perception does play a significant role in sound change (cf Chap. 5).

release movement is somewhat different. In this case contact in the dental region is broken last, the body of the tongue being already lowered for the vowel posture.

	Closing Gesture	Constriction	Opening Gesture
iti	35.0 (13.5)	59.5 (18.5)	56.3 (18.0)
utu	28.1 (5.6)	82.5 (22.8)	40.0 (12.2)
ata	10.6 (1.7)	97.5 (13.0)	16.9 (6.1)

Table 3.5a: Temporal measurements for [t]. In this and the following tables, standard deviations are given in parentheses.

[d] As mentioned earlier (§3.2), the articulatory gesture for [d] is remarkably different from that of [t]. This true even with regard to variation across vowel contexts, which appear to have less effect on temporal aspects of the gesture than was the case for [t], as can be seen by comparing Table 3.5b with Table 3.5a.

	Closing Gesture	Constriction	Opening Gesture
idi	27.5 (10.9)	52.4 (13.9)	38.8 (7.8)
udu	27.5 (13.9)	48.8 (13.6)	46.3 (14.1)
ada	25.0 (13.2)	35.0 (11.2)	33.8 (8.6)

Table 3.5b: Temporal measurements for [d]

As is evident in Fig. 3.5o, the closing gesture for [idi] begins primarily with contact on the alveolar ridge, and closure just behind the teeth coming afterwards. The release of the constriction also follows this pattern, indicating a rolling forward of the contact area. The same can be seen for both [udu] and [ada] (Figs. 3.5p and q), though the contact zone is retracted relative to [idi] (§3.5.2). Also characteristic of these two (though more so for [ada]) is the absence of lateral contact, as mentioned above (§3.5.2). In some instances, this lateral gap occurs as part of the opening gesture, while in others, most commonly with [a], it may occur throughout the articulation. The kind of palatalization or assibilation found for [t] in high vowel



contexts is only rarely in evidence for [d].

[n] Figs 3.5r to 3.5t, representing [n] in the three symmetrical contexts demonstrate again the similarity in gesture of this consonant to [d]. Table 3.5c, however, shows the temporal differences between the two. In general, the closing gesture for [n] is slower than that for [d], and the duration of the constriction somewhat longer. The release, however, differs little from that of [d], except for that involving [i], which has a longer mean transition.

	Closing Gesture	Constriction	Opening Gesture
ini	35.0 (20.0)	72.5 (9.7)	50.0 (7.1)
unu	40.0 (15.0)	72.5 (10.9)	40.0 (10.0)
ana	16.3 (4.8)	60.0 (7.1)	35.0 (5.0)

Table 3.5c: Temporal measurements for [n]

[s] In the discussion of spatial coarticulation, it was pointed out that little difference exists spatially in contact configurations for [s] in the different vowel contexts, but it was mentioned that there is variation in the temporal patterning. The transitional gestures for [isi] and [usu] are both considerably longer than for [asa], and both of these two, but particularly [usu], become somewhat palatalized in the opening gesture. On the other hand, the transitional movements for [asa] are normally quite free of palatal contact, although as Fig. 3.5w shows, there may be some contact involving the tongue rims. This is different from the release for [t], a fact which is also reflected in the different release rates for the two consonants.

	Closing Gesture	Constriction	Opening Gesture
isi	63.8 (21.2)	133.8 (17.3)	72.5 (25.4)
usu	71.3 (23.2)	70.0 (17.3)	91.3 (23.2)
asa	46.3 (9.9)	61.3 (12.7)	58.8 (12.7)

Table 3.5d: Temporal measurements for [s]

[ɲ] The closing gesture for [ɲ], regardless of vowel context, is essentially a straightforward raising of the tongue body, with some forward movement of the contact area; that is, the greatest contact is made initially in the rear of the contact area. This area varies slightly according to context, as pointed out earlier, but as shown in Table 3.5e, there is no substantial variation in the rate of closure for the different contexts. The release normally begins with a breaking of contact first where it is greatest (see Figs. 3.5x and y), and proceeds with a relatively gradual reduction of contact in the central area of the palate. Opening gesture rates are similar to those found for [s], with the slowest release occurring for [u], and little difference being found between [i] and [a]. All three vowels begin with a noticeable palatal off-glide from the consonant.

	Closing Gesture	Constriction	Opening Gesture
ipi	53.8 (14.9)	57.5 (23.3)	65.0 (27.8)
upu	55.0 (10.0)	51.3 (16.2)	93.8 (14.1)
apa	60.0 (12.2)	43.8 (18.0)	72.5 (16.4)

Table 3.5e: Temporal measurements for [ɲ]

[k] and [kp] Temporal aspects of the articulatory gesture for [k] and [kp], like the spatial considerations presented above, are essentially the same. Figs. 3.5aa to cc are arranged in pairs to facilitate comparison of the two. Again, it is not possible to chart the entire course of the articulation, though it would appear that a forward movement of the contact area occurs; that is, as for [d, n, ], contact occurs later in the anterior part of the contact region, and is released later in this region (see esp. Figs 3.5aa.i (íkíè) and aa.ii (íkípífák). This movement may be slight, but it is important to note, first, that it occurs for both [k] and [kp] and, second, even though slight, it would appear to preclude the possibility of [kp] being produced with a velaric airstream mechanism involving a backward movement of the tongue. This consideration is dealt with in greater detail below (§3.6).

Durational measurements for these two consonants are presented in Table 3.5f. Here it can be seen again that the two are essentially the same, especially with regard to the opening gesture, where transition rates show no substantial difference, neither across vowel contexts, nor between the two consonants. It may be noted, though, that

concerning the duration of constriction, [kp] shows considerably shorter times for [i] and [a] contexts than [k], and that in both cases the [u] environment demonstrates a longer closure. It is not clear why there should be a difference between [kp] and [k] for [i] and [a] contexts; the greater duration in the [u] environment for both is most likely a result of the proximity of place of articulation for the vowel and velar gesture. As for the closing gesture, values for [iki] are out of line with the others. In considering these values however, the relatively high standard deviations must also be taken into account.

	Closing Gesture	Constriction	Opening Gesture
iki	60.0 (21.4)	76.3 (23.4)	40.0 (16.6)
uku	37.5 (21.7)	91.3 (16.2)	43.8 (9.9)
aka	30.0 (20.0)	71.3 (6.0)	47.5 (9.7)
ikpi	41.3 (18.3)	51.3 (19.0)	45.0 (8.7)
ukpu	31.3 (7.8)	93.8 (18.0)	45.0 (5.0)
akpa	38.8 (15.4)	53.8 (15.8)	52.5 (8.3)

Table 3.5f: Temporal measurements of [k] and [kp].

### 3.5.9. Summary of temporal coarticulation (symmetrical environments)

The measurements and discussion presented above for the closing gesture, period of closure (or greatest constriction), and opening gesture for consonants in symmetrical environments indicate coarticulatory effects of the following nature.

For all the alveolar consonants, regardless of their differences, the quickest rates of transition (i.e., for both closing and opening gestures) were those involving the vowel [a] (and, it might be added, in the vast majority of cases, also the lowest standard deviation). The only case where the difference between rates for the three vowels did not appear to be significant was for [d], but despite this, rates for [a] still had the lowest means.

For the closing gesture, little difference is detectable between [i] and [u], though on the other hand, for the opening gesture, [i] clearly involved a slower release for [t], reflecting a tendency of that consonant towards palatalization (assibilation), while for [s], this palatalization was apparent for both [i] and [u].

No consistent patterning is apparent for the duration of the constriction itself with regard to vowel context. For both [d] and [n], the shortest closure was in the [a] context, an effect perhaps brought on by the height of the vowel (in conjunction with the weak nature of the gesture), while for [s], the [i] environment clearly induced a longer constriction.

Different patterns emerged for [ɲ], [k], and [kp], with little variation in closing gesture for [ɲ], though the constriction was shortest for the [a] environment, and the [u] context produced the slowest release rate. For the two velar articulations, of greatest interest are the longer closures with [u], and the consistency observed concerning release rates.

For the most part, these observations fit with current hypotheses concerning relatively independent control of tongue tip and blade as opposed to tongue body activity, and the relative invariance of targets over trajectories. These issues are not of central concern in the present work and need not be explored in detail here; reference may be made to, e.g., Farnetani *et al* (1985), and Kuehn and Moll (1976).

#### 3.5.10. Asymmetrical environments

The discussion above of spatial coarticulation in asymmetrical environments revealed a certain amount of influence from the preceding vowel, but established that the following vowel generally predominates with regard to contact configuration at the point of maximum contact.

Concerning dynamic aspects of articulation in symmetrical environments, variation in rate of closure and release were noted for the different vowels, and particularly for alveolar consonants. These variations, by and large, also obtain in asymmetrical environments though, again, not without some apparent interaction between the preceding and following vowels. Table 3.5g summarizes the results of measurements on the three phases of articulation for asymmetrical environments. These may be compared with the relevant tables in the preceding section to ascertain the variations in influence.

#### 3.5.11. Closing gesture

[t d n s] The pattern of variation in rates of closure for the different vowel contexts for alveolar consonants generally follows that as determined for symmetrical environments. For [t], closure is slowest for [i] and quickest for [a], though for [u],

	Closing Gesture	Constriction	Opening Gesture
itu	31.9 (9.3)	91.3 (15.4)	46.3 (9.9)
uti	30.0 (11.7)	70.0 (15.0)	71.3 (14.5)
ita	35.6 (8.8)	86.3 (16.5)	30.0 (7.1)
ati	18.8 (6.0)	67.5 (21.1)	61.3 (16.9)
uta	18.8 (9.3)	82.5 (21.7)	21.3 (6.0)
atu	20.0 (5.0)	81.3 (19.6)	48.8 (11.7)
idu	33.8 (11.1)	51.3 (11.7)	47.5 (6.6)
udi	37.5 (10.9)	47.5 (14.8)	50.0 (10.0)
ida	28.8 (11.7)	42.5 (21.7)	38.8 (7.8)
adi	21.3 (7.8)	38.8 (12.7)	38.8 (11.7)
uda	18.8 (6.0)	42.5 (12.0)	35.0 (10.0)
adu	25.0 (10.0)	27.5 (13.0)	52.5 (9.7)
inu	32.5 (12.0)	65.0 (11.2)	40.0 (8.7)
uni	33.8 (17.3)	66.3 (8.6)	50.0 (10.0)
ina	45.0 (11.2)	61.3 (6.0)	31.3 (3.3)
ani	27.5 (8.3)	58.8 (9.3)	47.5 (4.3)
una	23.8 (9.9)	45.0 (10.0)	35.0 (5.0)
anu	21.3 (7.8)	65.0 (11.2)	41.3 (6.0)
isu	61.3 (10.5)	87.5 (12.0)	42.5 (4.3)
usi	58.8 (6.0)	105.0 (18.0)	50.0 (7.1)
isa	46.3 (12.2)	73.8 (17.3)	46.3 (7.0)
asi	48.8 (6.0)	116.3 (19.3)	52.5 (13.0)
usa	41.3 (7.8)	77.5 (22.8)	47.5 (6.6)
asu	36.3 (4.8)	77.5 (26.8)	57.5 (10.9)
ipu	58.8 (20.3)	63.8 (22.3)	92.5 (12.0)
upi	63.8 (13.2)	65.0 (17.3)	52.5 (22.2)
ipa	50.0 (27.4)	62.5 (14.8)	88.8 (7.8)
api	66.3 (14.1)	57.5 (19.8)	53.8 (13.2)
upa	68.8 (7.8)	55.0 (12.2)	83.8 (16.5)
apu	71.3 (12.7)	50.0 (21.8)	82.5 (17.1)
iku	51.3 (22.0)	100.0 (26.5)	46.9 (9.0)
uki	27.5 (13.9)	81.3 (15.4)	46.3 (12.2)
ika	43.8 (12.2)	77.5 (15.6)	45.0 (14.1)
aki	27.5 (13.0)	50.0 (15.0)	41.3 (9.3)
uka	35.6 (18.6)	58.8 (22.0)	46.3 (7.0)
aku	31.3 (10.5)	56.3 (12.2)	47.5 (9.7)
ikpu	61.3 (11.7)	85.0 (15.8)	43.8 (12.2)
ukpi	30.0 (19.4)	75.0 (20.6)	37.5 (10.9)
ikpa	51.3 (23.2)	61.3 (17.6)	46.3 (15.8)
akpi	28.8 (12.7)	63.8 (18.7)	45.0 (5.0)
ukpa	36.3 (12.2)	61.3 (14.5)	37.5 (9.7)
akpu	30.0 (18.0)	67.5 (19.8)	35.0 (13.2)

Table 3.5g: Temporal measurements of Ibibio consonants in asymmetrical environments.



speed of closure appears largely influenced by the following vowel; i.e., speed of closure for [u] of [uti] is considerable slower than that of [uta].

For [d], and this time also for [n], no substantial variation in speed of closure is apparent, with the exception of [ina]. It is noteworthy, though, that despite the closeness in rates for the different vowel environments, where [i] is involved, whether preceding or following, the closure is always slower (except for [adi]), whereas when [a] is involved, the closure is always quicker. A similar pattern exists for [s], however in the instance the variation between vowels is perhaps somewhat more noticeable.

[ɲ] For [ɲ], the pattern reverses itself; that is, lower closure times occur with [i] as the preceding vowel, or with the presence of [i] as following vowel exerting an influence on the preceding vowel, and longer closure times occur with [a] as preceding vowel. Again, however, temporal variations across the different vowel contexts are not substantial, with the mean rate for [apu] (71.3 ms) being well within the standard deviation of the mean rate for [ipɲ] (50.0 ms; SD = 27.4).

[k] and [kp] For velar articulations, the pattern is also similar to what obtains in symmetrical environments, with closure from [i] having the slowest rate. In these cases there is no substantial difference between rates for [u] and [a], nor for rates between the two consonants.

### 3.5.12. Duration of constriction

In general, vowel context appears to have little consistent effect on the length of the closure. For [t], shorter closures are induced by a following [i], whereas for [s], following [i] conditioned longer constrictions. For both [d] and [n], there is no substantial variation across vowel contexts, with one exception in each case, [adu] and [una]. For [ɲ], again, there is little variation in duration of constriction, though the presence of [i] suggests a somewhat longer closure. Finally, for the velar articulations, the combined forces of the two high vowels, in both cases induce a longer mean duration.

### 3.5.13. Opening Gesture

Regarding the opening gesture we again find, for the alveolar consonants, that by and large following [i] induces the slower releases, while [a] brings on the quickest. And, as was observed in other situations, the pattern is most well-defined for [t], though less so for the other consonants. In fact, when the variation associated with the means for [d], [n], and [s] is taken into account, there is very little difference in rates of

release for these consonants, though for [s], it is marginally slower. For [ɲ], the fastest rate of release is associated with a following [i], which shows a substantial difference from rates for [u] and [a], reflecting the fact that both these articulations share the same articulators. The speed of the opening gesture for [ɲ] whether followed by [u] or [a] varies little. Finally, for the velar articulations, there is apparently no effect of vowel context on the rate of release, as times for opening gestures for both [k] and [kp] are quite consistent.

#### 3.5.14. Vowel to vowel coarticulation

A few remarks may be made regarding vowel to vowel coarticulation in Ibibio. In discussing spatial coarticulation, it was established that the following vowel exerts the greatest determining influence on the extent and location of linguo-palatal contact at the point of maximum contact. As can be seen in many of the EPG charts presented above, this point of maximum contact generally occurs early on in the constriction phase. The dominating influence of  $V_2$  throughout the constriction is clearly demonstrated in the two following sets of charts (Fig. 3.5dd.i and ii), representing [ika] and [aki] sequences, respectively. In the sequence [ika], there is no evidence at all of the fronting of [k] associated with [ki] - i.e., the contact configuration associated with [ka] is assumed from the beginning of the closure. On the other hand, [aki] demonstrates a fronting movement of the contact area shortly after the achievement of closure. It should be borne in mind, however, that inspection of the charts for the various vowel/consonant combinations revealed considerable variation which was not apparently correlated with the combination.

#### 3.5.15. Summary of the EPG investigation

To review the findings gleaned from the electropalatographic investigation, I return to the questions posed at the outset of the EPG discussion. As expected, question 1 can be answered 'yes': the discussion of spatial coarticulation showed clearly that the place of articulation can vary according to vowel context; this is most apparent for Ibibio [d, n]. However in other cases, particularly for [t], it seems more appropriate to consider the observed variation not as a change in place of articulation (as implied by the question), but rather as an extension of the existing place of articulation (cf. Farnetani *et al* 1985).

For question 2, it was found that for both spatial and temporal considerations, there are differences as to the effect of the three vowels on the nature of the closure. Whether or not a hierarchy of influence can be established concerning these differences

is not a straightforward matter. Problems as to what criteria should be used in establishing such a hierarchy have been pointed to, and it has also become apparent that different hierarchies might obtain for vowels in conjunction with different consonants; i.e., the question of a hierarchy of vowel influence, if this is taken to refer to an inherent characteristic (whether phonetic or phonological) of vowels, is in fact an oversimplification. Observed effects of vowels on consonants (or for that matter consonants on vowels which, although ignored in this discussion, are nonetheless quite real) are the result of an interaction between the two articulations.

In *Ibibio*, it appears that the greatest coarticulatory influence (question 3) is associated with the following vowel, that anticipatory effects predominate. Again, however, the issue is not a simple one, as variations were found depending on the particular VCV sequence.

Regarding the fourth question, it was established that there is, as Recasens (1984a) claimed, an inverse relationship between the amount of tongue contact and the degree of coarticulation. This claim needs to be modified, however, to take into account place of articulation, and whether spatial or temporal effects are being considered. At least for the alveolars, Recasens' claim holds true; for the palatal [j], which has substantial contact, there was also a fair amount of coarticulatory variation spatially; however, as much of the evidence presented here suggests, and as is shown below (Chapter Four), this may be considered a weakening articulation and therefore likely susceptible to greater coarticulatory effects. On the other hand, the velar articulations, which also involve substantial contact, also show considerable movement in place of articulation according to vowel context, but are relatively consistent across vowel contexts with regard to temporal considerations.

Finally, question 5 asked whether coarticulatory effects as revealed by the foregoing considerations vary across different places of articulation. This is the case, as the previous paragraphs have revealed; any discussion of the nature of coarticulatory effects must take into account not only the place of adjacent articulations, but also the active articulator in each case.

### 3.6. The Ibibio labial-velar stop

#### 3.6.1. Introduction

Labial-velar stops are relatively rare in the world's languages. Maddieson (1984), in the most recent and perhaps most comprehensive phonological survey of the world's languages<sup>46</sup>, reports labial-velar stops in only 20 (i.e., 6.3%) of the 317 languages surveyed. Of these 20, all but one are found in Africa - mostly West Africa, and mostly of the Niger-Congo family. This one, Iai, is classified as Austro-Tai and is located in the Pacific region. Labial-velar stops are also known to exist in certain Papuan languages<sup>47</sup>, and a voiceless labial-velar stop has also been reported by Catford (1977: 190) for Lak, a Caucasian language, though it is said to be a realization of labialized [k], and not distinctive in its own right. West Africa, then, is the major location in the world for these doubly articulated stops; Ladefoged (1964), in his phonetic survey of West African languages reports voiceless labial-velar stops in 33 of the 61 languages covered by the survey (i.e., 54%)<sup>48</sup>. Maddieson's survey suggests that both a voiceless and a voiced stop may be expected if a language has labial-velars at all. However, the voiceless stop, by Ladefoged's report, appears to be more frequent; two languages in the survey had only the voiced variant, while nine had only the voiceless. The other 24 had both.

Despite their frequency in West African languages, the relative rarity of these stops throughout the world (and in particular their absence in the major European languages) has meant that they have received little attention in the literature. Instrumental phonetic analyses have been presented most importantly by Ladefoged in the above mentioned work, by Garnes (1975) for Ibibio, and by Dogil (1988) for Baule. Painter (1978) also gives some discussion of labial-velars in an article dealing primarily with pitch and laryngeal mechanisms, Ward (1933), for Efik, presents kymograph tracings of [kp], but no systematic analysis, and finally, Ohala and Lorentz (1978) present a general discussion of phonetic characteristics of labial-velar articulations, without focussing on stops. Apart from these studies, impressionistic

<sup>46</sup> Other surveys, such as Ruhlen (1976) and Sherman (1975) may have included more languages, but have been more restricted in other ways; Sherman, for example, looks only at stops and fricatives.

<sup>47</sup> Dedua and Yeletnye are two, demonstrated in the *Sounds of the World's Languages* package compiled by Ladefoged and Maddieson for use on Macintosh computers (Version 3.1 1990).

<sup>48</sup> Ladefoged actually mentions 37 languages having labial-velars, but four of these have velarized labials rather than full double stops. If we are to include these, then one might also want to include labialized velars - except that would in some cases present problems, as many of these languages have both /kp/ and /k<sup>w</sup>/. On the other hand, one might question the existence of /k<sup>w</sup>/; at least in Efik, one of the 12 languages said to have both, what was earlier analysed as /k<sup>w</sup>/ is in fact now analysed as /kw/ (and phonetically is often realized as [ku]). One language only (Igbo) was found to have both /kp/ and /p<sup>w</sup>/. Two languages which had only /gb/ were excluded from Ladefoged's count.

descriptions of the articulatory and auditory characteristics of labial-velar stops can often be found in the Africanist linguistic literature.

Phonological discussion of labial-velar stops is equally scanty, with perhaps the most important studies being found in Anderson (1976), Ohala (1979), and Sagey (1986). Phonological issues of the kind discussed in these studies are tangential to the present work, and accordingly will receive little attention. The description presented in this section, however, is considered relevant for any adequate phonological treatment of labial-velar stops.

In addition to contributing to the more general aims of the dissertation, this section is intended to add to the literature on the articulatory and acoustic structure, and the general nature, of these doubly-articulated stops. The labial-velar stop of Ibibio is examined using the techniques of spectrography, aerometry, laryngography, and electropalatography. Oral and pharyngeal air pressure recordings of Ibibio [kp] made available to me by Peter Ladefoged have also proved useful in understanding the nature of Ibibio labial-velars. Before entering into the discussion of these stops in Ibibio, a brief review of other descriptions of labial-velars is presented.

### 3.6.2. Notes on previous work

#### 3.6.2.1. Impressionistic reports

One of the earliest descriptions of labial-velar stops is found in Westermann and Ward (1933). Here, the two component articulations are described as being simultaneous - having no on-glide to the velar closure, and with a simultaneous, unaspirated release of the two closures (p. 58) - though curiously it is also claimed that, "the on-glide from the vowel makes it easier to hear the k and g" (p. 59). The authors further suggest that while the labial element is perceptually more salient for Europeans, for Africans it is the velar element which predominates. In support of this, they cite evidence of sound change claiming that, "where kp or gb are weakened, it is the labial element which disappears and the velar element remains, sometimes reduced to x or ɣ" (p. 58). Although they present no examples to justify their assertion at that point, elsewhere in the text (p. 108), correspondences are presented from the Nupoid languages Gbari and Nupe, and also from Bari and Kakwa ( $k^w \sim kp$ ,  $g^w \sim gb$  in both cases) which, at least to a limited extent, confirm their conclusions<sup>49</sup>. On the other hand, it is not immediately clear why perception should be different for Africans (i.e.,

---

<sup>49</sup> Gbari is now usually referred to as Gwari; the affiliation of Bari and Kakwa is not clear from their discussion, though Bari could be the Adamawa language also known as Nyamnyam.



native speakers of the languages in question) and non-Africans; in any case, it is no difficult task to find instances of sound change involving labial-velars where it is the labial element which survives - the Lower Cross languages being a case in point.

Welmers (1973) begins his chapter on consonant systems with a brief discussion of labial-velars. A number of his observations are worth noting for our present purposes: first, the claim is made that, "the velar component does not in any way precede the bilabial component" (p. 46); second, Welmers makes reference to the great amount of variability found in the production of these stops: "there are just about as many [labial-velar] sounds as there are languages which have one," (p. 46)<sup>50</sup> and third, the existence of suction during the closure in some languages, which results in a 'pop' on release, is noted. Apart from these characteristics, he observes that the two closures may involve different degrees of 'fortition', and that they may vary with regard to the nature of their release, with the labial release in some languages being more "relaxed", giving the effect of a "[w] off-glide".

Welmers' observations have been echoed by others; it has often been observed that, auditorily, labial-velars tend to resemble labials more than they do velars. Ladefoged (1964: 12) compares these to "velarized labials, [p<sup>w</sup>, b<sup>w</sup>]", for example, and observes that labial-velar stops tend to impart a labialized quality to following vowels (cf. also Abraham 1940 on Tiv). Ohala and Lorentz (1978) have provided acoustically based explanations for these tendencies. Comparisons have also been made to labial implosives by Ladefoged (1964: 13) and Painter (1978), and by Elugbe (1989) as a general characteristic of labial-velars in the Edoid languages. Bearth and Zemp (1967: 14) describe the labial-velar stops of Dan as having "strong bilabial implosion", and Puesch (1989) describes a voiced implosive labial-velar for Bekwil<sup>51</sup>.

### 3.6.2.2. Articulatory characteristics

In addition to the general observation that labial-velar stops involve two simultaneous articulations<sup>52</sup>, Ladefoged (1964) has distinguished three different types,

<sup>50</sup> It is probably this variability has led not only to the discrepancies in observations between Westermann and Ward (1933) on one hand, claiming the velar element to be predominant, and others who have attributed greater saliency to the labial element, but more importantly, it is this variability that has led to the wide range of reflexes found developing from labial-velars (see Chap. 5).

<sup>51</sup> Dan is a Kwa language spoken in Cote d'Ivoire; Bekwil is Bantu (A-85b), spoken in Gabon.

<sup>52</sup> Except for Westermann and Ward (1933) cited above, what is meant by 'simultaneous' has not usually been specified; i.e. whether the term is intended to mean that the two articulations are completely synchronous or simply overlapping.

which differ in their use and combination of airstream mechanisms. The first type employs a simple pulmonic egressive airstream, the second combines this airstream mechanism with a velaric ingressive one, which is said to be a result of a lowering of the jaw and a backward movement of the dorso-velar contact after the two closures have been made (p. 9). The third type adds to these two a glottalic ingressive airstream<sup>53</sup>. Apart from the addition of the glottalic airstream mechanism for type three, it appears from Ladefoged that this type of [kp] is distinguished from type two in that it is partially voiced (see Ladefoged's Fig. 4, p. 8, and Table 3, p. 10). Of the three types, the first is apparently the rarest, turning up in only two of the 33 languages found to have labial-velars, while type two occurs in 23 of these languages. Ladefoged's work on Yoruba showed labial-velar stops in that language to be of the second type, and he suggested that the labial-velar stop of Ibibio is likewise produced with a combination of pulmonic egressive and velaric ingressive airstream mechanisms (p. 9)<sup>54</sup>. Ladefoged's evidence that a velaric ingressive airstream is used raises the question of possible similarities between these stops and labial clicks found in the Khoisan languages of Southern Africa. This question is returned to briefly below.

Painter (1978), in the course of an investigation into laryngeal mechanisms and pitch control, examined the voiced and voiceless labial-velar stops of Yoruba and Gã<sup>55</sup>, using only one speaker in each case, with tokens of these consonants recorded in a variety of vocalic and tonal contexts. Based on F0 measurements taken at different times during the production of these stops, which were correlated with pharyngeal and oral pressure measurements, Painter was able to establish the relative timing of the two closures. For Yoruba, it was determined that the bilabial closure was made 30 ms prior to the velar closure, which in turn was released 40 ms before the release of the bilabial stop. On the other hand, for Gã, the two closures were synchronous, but again the velar release preceded the bilabial one, in this case by 50 ms.

### 3.6.2.3. Acoustic Structure

Commenting on the acoustic nature of Yoruba labial-velars, Ladefoged notes especially the upward transition of F2 on release, a rapid rate of transition, and a tendency for the transition to have two loci, one at about 1,200 Hz and the other at

<sup>53</sup> Throughout this section and the rest of the work, I will refer to these simply as types 1, 2, and 3, respectively.

<sup>54</sup> My own auditory impressions of labial-velars in these two languages suggests there are differences between the two, which has been confirmed by native speakers of the two languages. One of the components of an Ibibio accent in speaking Yoruba is the difference in [kp]. This question is taken up below.

<sup>55</sup> Yoruba and Gã are both Kwa languages, as is Baule, mentioned below.

about 2,200 Hz. This was especially noticeable in association with high front vowels; the phenomenon was not discussed in depth by Ladefoged. These observations were based on utterances of the voiced labial-velar stop [gb] in combination with each of the seven oral vowels of Yoruba, and using two native speakers of Yoruba.

Dogil (1988) presents an investigation of the labial-velar stops, [kp] and [gb], of Baule, in comparison with the simple voiced and voiceless labial and velar stops of that language. As with Painter, only one speaker was used for the investigation, and apparently only one vowel context, [a\_a], was used, though with different tonal combinations, and only one token of each VCV combination analysed. His main aim in that paper was to determine if invariant cues for place of articulation exist for labial-velars, and for this some support, though inconclusive, is claimed. Most importantly, F2 transitions are said to resemble those of labials in direction, but are shorter in duration and more prominent. With regard to the spectral nature of the release, it is said to be characterized by "a compact concentration of energy in the high frequency region (above 3000 Hz)". Dogil concludes, however, that he is unable to make any strong claims regarding the invariance of acoustic cues for a labial-velar place of articulation. What appeared of greatest interest was the 'strength' of the release.

Garnes (1975) was also concerned with possible cues for place of articulation for labial-velars, describing Ibibio [kp] from the point of view of locus theory. Again, the research presented is based on utterances from one speaker. She concludes that [kp] is indeed different from both [p] and [k] with regard to its transitions and loci. The transitions associated with the labial-velar release are rising, as for labials, but steeper than those of simple bilabials, suggesting a faster transition, a lower locus, or both.

Concerning the temporal structure of [kp], Garnes again concludes it to be of a different nature than that of both [p] and [k]). The labial-velar articulation is said to comprise three phases; an onset phase consisting of low frequency, aperiodic vocal fold vibrations, a plosive gap (silent interval), and the release. The onset phase is said to be absent for the two simple stops, and therefore a distinguishing characteristic of [kp]. In addition, the release phase of [kp] is pre-voiced, with an average of 22 ms of voicing before the actual release (i.e., before vowel onset). In terms of total duration, [kp] and [k] were found to be virtually identical, while [p] was of a shorter duration. Further discussion of Garnes' work is included below.

### 3.6.3. Impressionistic description of Ibibio labial-velars

In light of Welmers' remark quoted above concerning the timing of the two articulations, and the more general observation that the two closures are simultaneous, it is interesting to note that orthographically, labial-velar stops have always been rendered with the velar element first. The Ibibio labial-velar, in fact does not give the impression of total simultaneity, but usually one of the velar closure occurring first. I have on occasion observed linguistically naive non-Africans first attempts at pronouncing this sound as a distinct sequence 'k-p', but never as 'p-k'<sup>56</sup>. Ward (1933: 7) notes for Efik a raising of the larynx during the closure; this characteristic is also normally apparent for Ibibio, but it may be noted that a raising of the larynx is also present (both for Ibibio and Efik) for simple velars as well. A sharp *downward* movement of the larynx (i.e., more than compensating for earlier raising) is also frequently quite noticeable for Ibibio.

Auditorily, a certain amount a variability is noticeable, particularly in the presence or absence of a 'pop' on release. (This brings to mind again possible similarities between these stops and labial clicks - auditorily the labial-velar never very closely resembles a labial click.) This 'pop', on occasion may be quite loud, but more frequently is not distinct. On the other hand, the impression of implosion or suction is always present, and in learning to pronounce this sound myself, the most satisfactory reaction from native speakers was when I produced it with a glottalic ingressive airstream (as well as a velaric ingressive one). As noted earlier, labial-velars have a tendency to impart a labialized quality to the following vowel; this is also the case for Ibibio. The other salient characteristic of Ibibio [kp] is its voiced release; this is quite noticeable in most Lower Cross languages. In fact Ward (1933: 7), for Efik, advises, "Learners should try to make [it] somewhat like **kb**," though she goes on to claim that, "there is no voice in the stop".

Finally, it is interesting to note that among the Lower Cross languages, /kp/ corresponds with /p/ and /b/ and /k<sup>w</sup>/ cross-dialectally or cross-linguistically, as discussed in §3.7 (i.e., \*kp > kp, p, b, or /k<sup>w</sup>/; see Chapter 4).

### 3.6.4. Instrumental investigations

#### 3.6.4.1. Acoustic structure

To examine the acoustic structure of the Ibibio labial-velar stop [kp], as compared to the simple stops [b], [p], and [k], a list of 50 Ibibio words was composed

<sup>56</sup> It is not clear to what extent this is a result of orthographic influence.

(see Appendix C), comprising tokens of these stops in VCV sequence. The list was recorded by eight native speakers using a Revox 77A recorder (@7.5 ips) at the University of Calabar in Nigeria, under recording conditions that were less than ideal (e.g., the recording studio was not a sound proof room). The eight speakers represented 3 different dialect areas within Ibibio (varieties which differ mainly with regard to vowel systems and certain morphological characteristics); 5 of the speakers were in their early to mid twenties, and the other three were in their late thirties to early forties. Wideband spectrograms were made of recordings of 400 words. Of these, 102 tokens of [kp], 71 of [b], 59 of [p] and 84 of [k] were analysed. (One informant's results were discarded, and among the others occasional mistakes were made; consequently the maximum possible number of tokens was not obtained.)

In general, acoustic characteristics of Ibibio labial-velars as demonstrated by these speakers are in accord with what has been observed elsewhere for labial-velar stops and, in particular, with Garnes' observations in her examination of Ibibio. First, the F2 transitions associated with the release of the labial-velar resemble those found for labials in that they are negative (i.e., the locus of the transition lower than the steady-state of the formant). But, as also noted for other languages, they appear to be steeper and of greater intensity than those associated with simple labials. Durations of the transitions for labial-velars and simple labials appear to be similar, but the transition for [kp] has a faster rate of change in that its locus is lower (at about 1,000 Hz) than that of simple labials. Only rarely (4 cases from 2 speakers) did the CV F2 transition have a clearly discernible positive trend, and each of these cases involved a high vowel. Table 3.6a presents values typical of CV F2 transitions for labials, velars, and labial-velars in three vowel contexts<sup>57</sup>.

	loc	F2	dur	loc	F2	dur	loc	F2	dur
/bV, pV/	2.0	2.2	40	1.5	1.8	50	1.25	1.6	50
/kV/	2.5	2.2	35	-	-	-	1.6	1.5	40
/kpV/	2.4/1.0	2.2	35/30	1.0	1.8	50	.9	1.3	50
	/i/			/ε/			/a/		

Table 3.6a: Typical values for CV F2 transitions for labials, velars, and labial-velars in three vowel contexts. F2 and locus values are in kHz, durations are in ms. Empty cells represent sequences not present in the data.

<sup>57</sup> Speaker means were not calculated for transition values due to the small number of tokens of the different vowel contexts. The fact that the subject pool was of mixed dialect origin meant that cross-speaker comparison of means would have been dubious, in any case. F3 transition values were not calculated because too frequently the locus of these transitions was undeterminable; on the other hand, the direction of the transition was normally apparent.



Table 3.6b gives values for F2 VC transitions, and Figure 3.6a a schematic comparison of F2 and F3 transitions associated with different places of articulation in different vowel contexts. Sample spectrograms of [kp] compared to simple labial and velar stops, in similar vowel contexts, are presented in Figures 3.6b, 3.6c, and 3.6d.

F2 transitions into and out of the consonant in a VCV sequence are generally expected to mirror each other (cf. Fry 1979); i.e., for labials, the VC transition is normally negative, as it is for the CV transition, and for velars a positive VC transition is expected. This is reflected in the values for these consonants given in Tables 3.6a and b and illustrated in Figures 3.6b, c, and d. This symmetry does not normally obtain with F2 VC transitions for the labial-velar.

	F2	loc	dur	F2	loc	dur	F2	loc	dur
/Vb, Vp/	-	-	-	2.0	1.6	40	1.6	1.25	40
/Vk/	2.2	2.3	40	2.0	2.2	40	1.5	1.55	35
/Vkp/	2.2	2.3/1.0	40/30	1.9	2.2/1.0	30/50	1.3	1.0	45
	/i/			/ε/			/a/		

Table 3.6b: Typical values for VC F2 transitions for labials, velars, and labial-velars in three vowel contexts. F2 and locus values are in kHz, durations are in ms. Empty cells indicate sequences not present in the data.

For the labial-velar, the release (CV) transition almost always resembles that of the simple labial with regard to directionality, the closing (VC) transition is variable. It may be negative, but may also appear as a positive transition, and indeed in some instances both negative and positive transitions occur associated with the same closure<sup>58</sup>. A weak correlation between the direction of the transition and vowel height was observable in that negative transitions are most strongly associated with low vowels (VC transitions from [a ε i] were examined), while positive transitions occurred with greater frequency with high vowels. In keeping with this trend, the mid vowel (a close [ε] for most speakers), showed variability between positive and negative transitions, and also demonstrated most frequently and most clearly the double transition phenomenon. In only 14% of cases (including doubtful ones) was a positive F2 transition found with preceding [a]; interestingly, these all came from two of the eight speakers, both of whom hail from the same dialect region. With preceding [i], negative transitions were found in 11% of cases, and double ones in 22%. Again

<sup>58</sup> It was mentioned above that Ladefoged observed double transitions for the Yoruba release; these did not resemble the double transitions reported here (Ladefoged, personal communication).

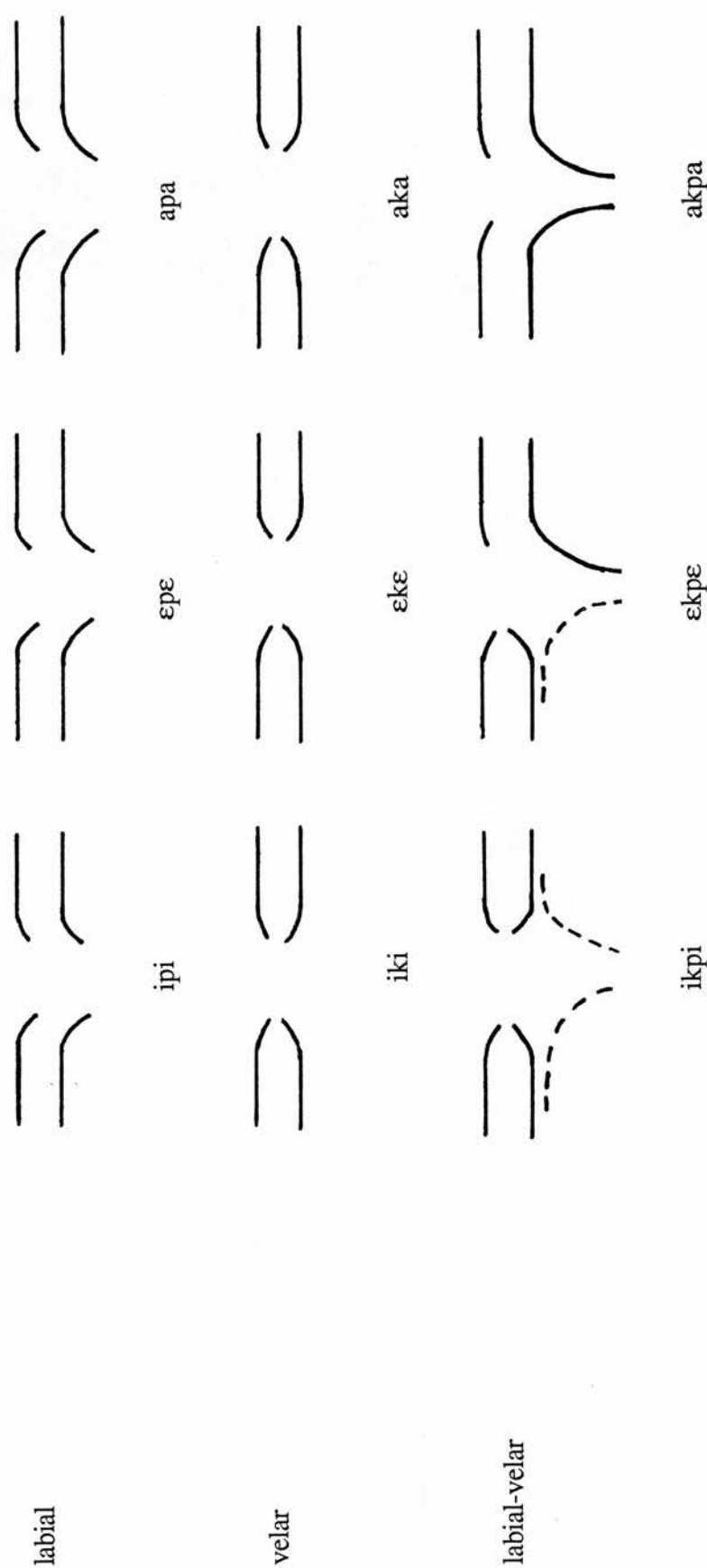
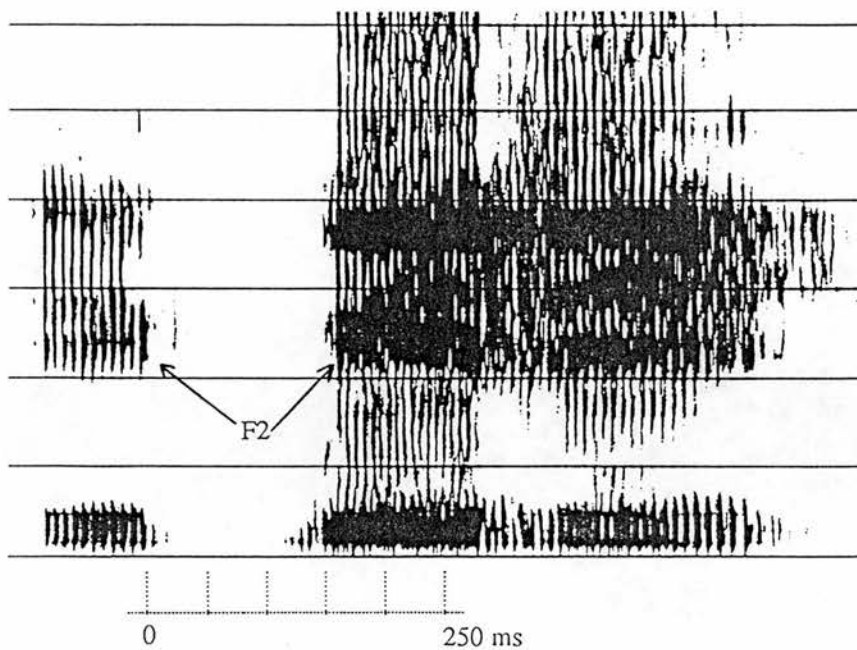
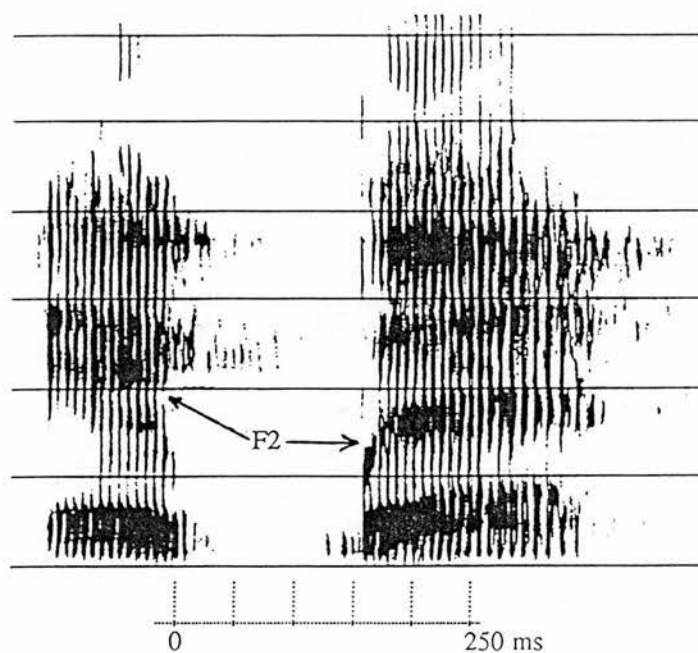


Figure 3.6a: Schematic representation showing direction and shape of F2 and F3 transitions for Ibibio labial, velar, and labial-velar stops in selected vowel contexts. Broken line indicates secondary, weaker transition.

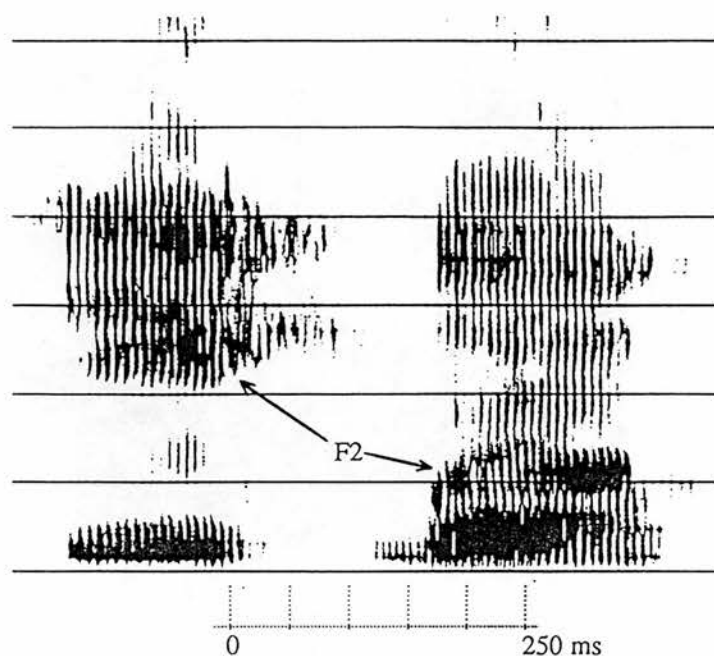


(a) [ikpíḍi]: TD of [kp] 148 ms; VTT 22 ms; VOT 36 ms.

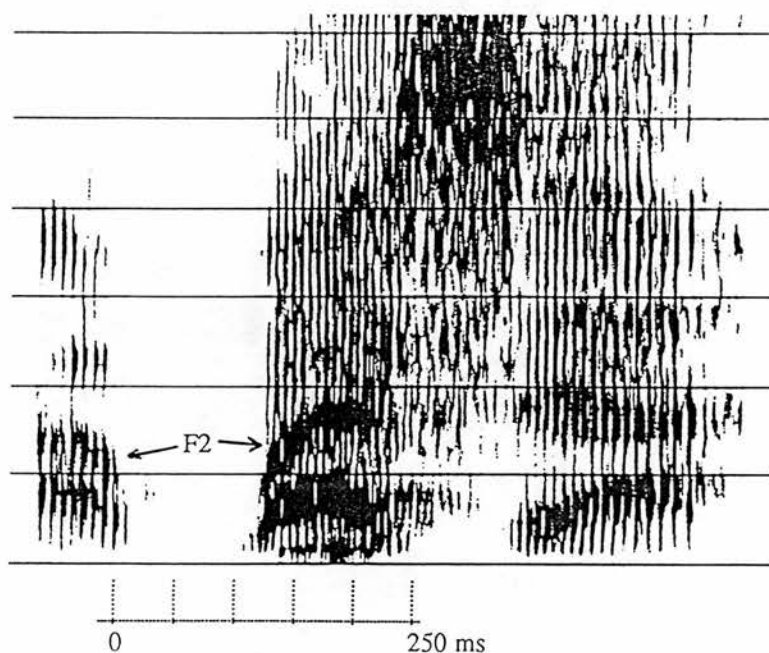


(b) [ékpê]: TD of [kp] 156 ms; VTT 38 ms; VOT 36 ms.

Fig. 3.6b: Sample spectrograms of Ibibio labial-velars: (a) [ikpíḍi], 'if we would come'; (b) [ékpê] 'leopard'. Frequency divisions are in 1 kHz steps, F2 is indicated. (Speaker: E.E. Akpan)

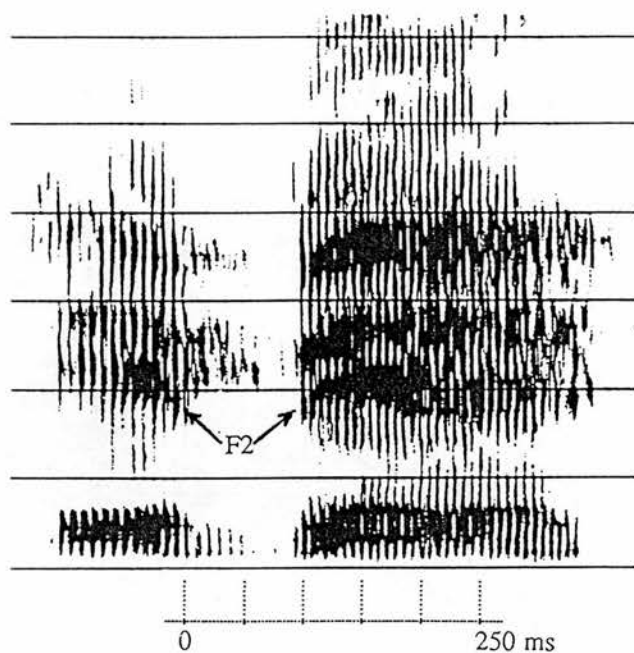


(c) [íkþó]: TD of [kp] 181 ms; VTT 47 ms; VOT 48 ms.

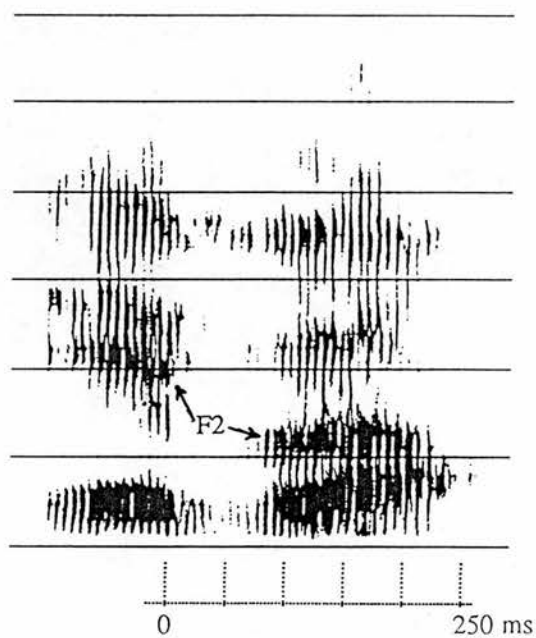


(d) [àkpásà]: TD of [kp] 117 ms; VTT 45 ms; VOT 23 ms.

Fig. 3.6b con't: Sample spectrograms of Ibibio labial-velars: (c) [íkþó], 'funeral service'; (d) [àkpásà], 'basket'. Frequency divisions are in 1 kHz steps, F2 is indicated. (Speaker: E.E. Akpan)



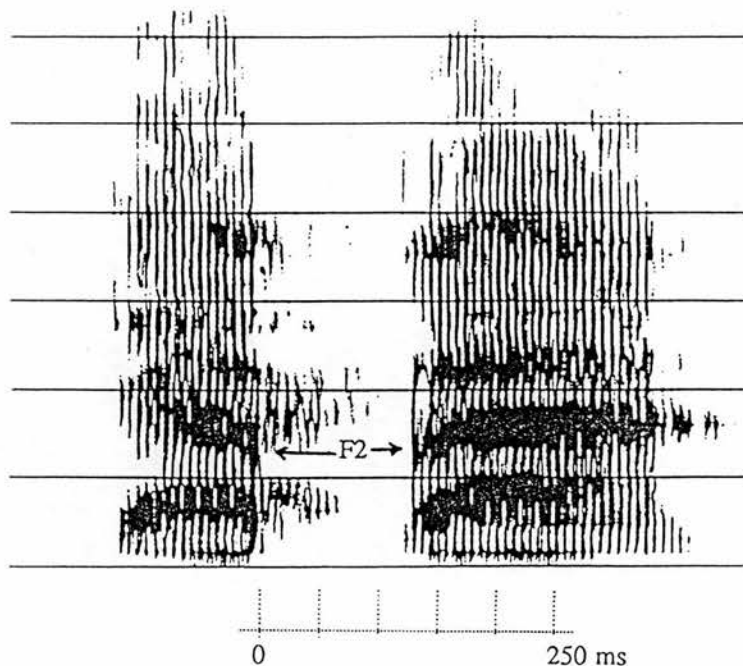
(a) [èbé]: Dur of [b] 97 ms.



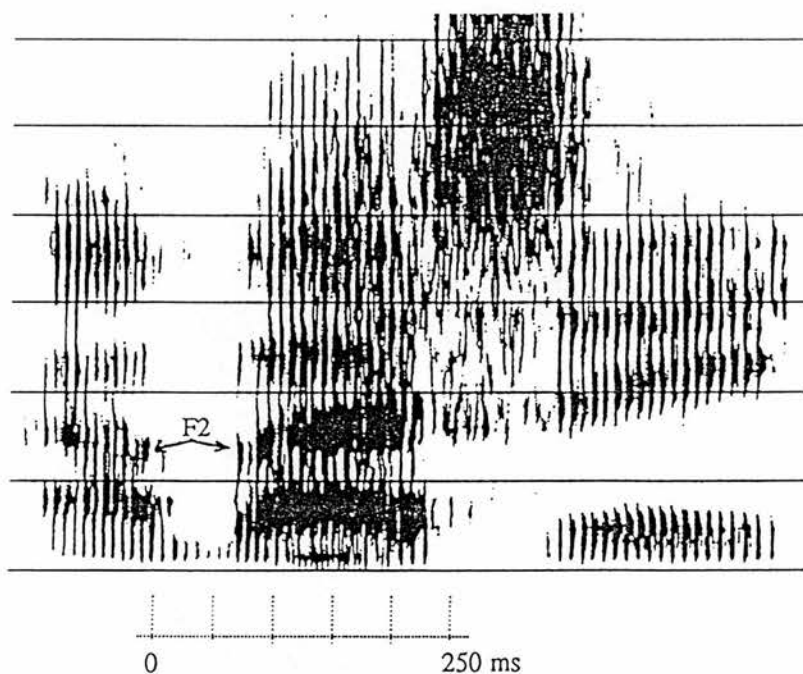
(b) [ébôk]: Dur of [b] 80 ms.

Fig. 3.6c: Sample spectrograms of Ibibio labials: (a) [èbé] 'breast'; (b) [ébôk] 'monkey'. Frequency divisions are in 1 kHz steps, F2 is indicated. (Speaker: E.E. Akpan)



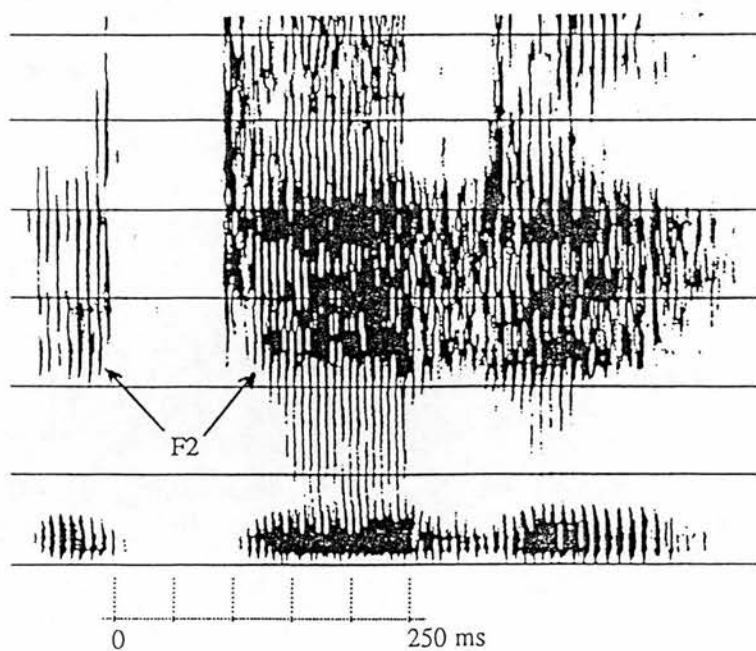


(c) [dápá]: Dur of [p] 123 ms; VTT 23 ms; VOT 8 ms.

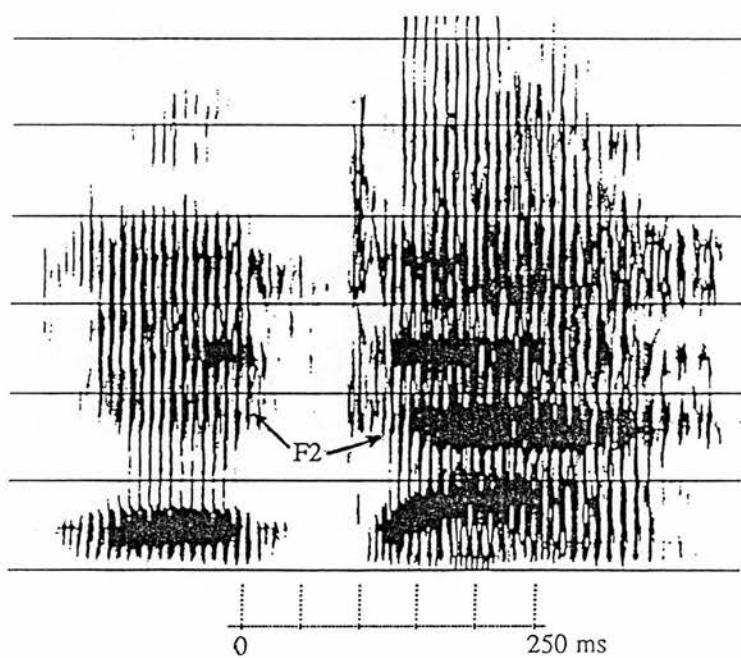


(d) [àbàšĩ]: Dur of [b] 69 ms.

Fig. 3.6c con't: Sample spectrograms of Ibibio labials: (c) [dápá] 'dream (v.)'; (d) [àbàšĩ] 'supreme god'. Frequency divisions are in 1 kHz steps, F2 is indicated. (Speaker: E.E. Akpan)

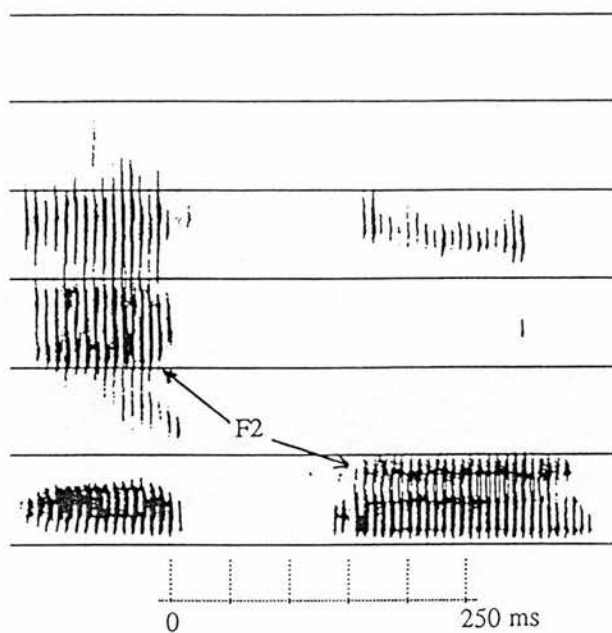


(a) [ikídi]: Dur of [k] 94 ms; VTT 36 ms; VOT 10 ms.

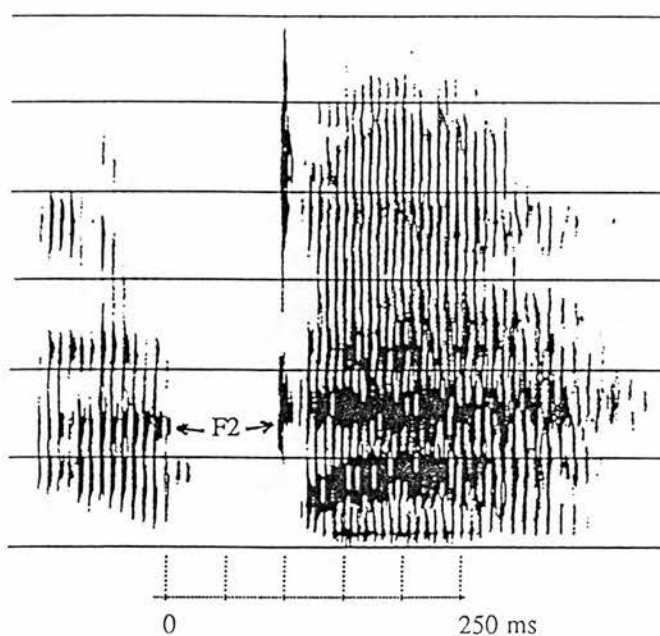


(b) [èkà]: Dur of [k] 81 ms; VTT 36 ms; VOT 26 ms.

Fig. 3.6d: Sample spectrograms of Ibibio velars: (a) [ikídi] 'as we came'; (b) [èkà] 'mother'. Frequency divisions are in 1 kHz steps, F2 is indicated. (Speaker: E.E. Akpan)



(c) [ékú]: Dur of [k] 114 ms; VTT 36 ms; VOT 20 ms.



(d) [àkâ]: Dur of [k] 90 ms; VTT 22 ms; VOT 9 ms.

Fig. 3.6d con't: Sample spectrograms of Ibibio velars: (c) [ékú] 'meat'; (d) [àkâ] 's/he goes'. Frequency divisions are in 1 kHz steps, F2 is indicated. (Speaker: E.E. Akpan)

these were concentrated in a subset of the subject pool - 3 of the 8 - and of these, two are natives of the same village, and of the same age group. For [ɛ], 38% of tokens showed negative transitions, 33% showed positive ones, and 21% had double transitions (in other cases, transitions either appeared to be flat, or were unidentifiable). The variation found here spread across the group. All but one of the speakers had at least one instance of a double transition, and apart from these there was, generally speaking, no preference for positive or negative transitions within speakers. This was contradicted in two cases: one speaker had positive transitions where he didn't have double ones (one of the two who showed these for [a]), and one had only negative if not double (one of those who also had negative transitions for [i]).

Since negative F2 transitions are associated with labiality, and positive ones with velarity, it is suggested the observed variation can be considered a reflection of an asynchrony in the timing of the two closures; i.e., where only a strong negative transition is present (e.g., Fig.3.6b (a)), it may be assumed that the labial closure precedes (or is at least synchronous with) the velar one, and where a positive transition has occurred, it is the velar closure which must have been achieved earlier (as in Fig. 3.6b (b)). On release, since there is normally no evidence of a positive F2 transition that could be associated with a velar release, it appears that the velar release has already occurred prior to the labial one.

There is no ready interpretation available for the double transitions. It was once thought that these might also reflect an asynchrony in the labial and velar closures, as tokens of double transitions in these data where the loci are clear indicate that the positive transition terminates approximately 20 ms earlier than the negative one, suggesting an asynchrony; i.e., the velar closure preceding the labial one, by that amount. It might also be assumed, then, that an asynchrony of more than this amount (or much less) would not result in a double transition. Ladefoged (personal communication) however, has suggested the secondary transition (weaker, and negative) reflects movement posterior to the velar closure. In this connection, it may be noted that in the spectrographic investigation, one token of [k] also showed this double transition, albeit faintly, to some extent supporting Ladefoged's suggestion, and indicating that these double transitions are in fact not reflecting a double closure.

That the variability is at least to a certain extent, but not consistently, correlated with vowel height, suggests that the duration of the articulatory gesture for [k] associated with different vowels may be a factor in the asynchrony observed between

the two articulations (assuming durations for labial closing and opening gestures remain relatively unaffected by vowel context). This, however, does not appear to be the case; the velar closing gesture takes longest for [i] contexts (cf. Tables 3.5f, 3.5g, above), and therefore the expected result would be for the labial closure to occur earlier, resulting in negative transitions. Regarding the release, little variation was found for velars across vowels.

#### 3.6.4.2. Burst spectra

It was claimed by Garnes (1975) that the labial-velar burst pattern was distinct from that of other stops in a number of ways: that it has a high frequency component (6 - 7 kHz); that it has weak energy spread throughout the higher frequencies (i.e., above 3.6 kHz); and, also that energy in the lower frequency range was absent. Examination of burst spectra in the present work do not confirm Garnes' findings, but it must be acknowledged that problems exist in my own data with regard to determining these spectra. There is a noise band that is often found extending into the silent interval of Ibibio stops (evident in certain tokens given in Figs. 3.6b, c, and d), regardless of place of articulation, and occasionally across the entire gap. Readings of burst spectra, in many cases then, may have been contaminated by the presence of this noise band.

The energy present in the spectrum at release appears primarily in two areas - in the lower frequency range, i.e., below 1.2 kHz, and in the mid range, from 2 - 4 kHz. The lower concentration could indeed be a reflection of a labial release, and this would not be unexpected, given the evidence from F2 transitions discussed above; on the other hand the lower end of this energy concentration is almost certainly to be associated with the strong prevoicing of the release. The energy found in the mid range could possibly be associated with a velar aspect of the release, but it is in this range that the noise band normally occurs, and it is unfortunately not possible to distinguish this noise from what might be legitimately associated with the release. There is little evidence in my own data to support Garnes' claim that there is a concentration of energy in the 6 - 7 kHz range associated with the labial-velar, though on occasion there is energy present throughout the spectrum, extending quite high in the frequency range. In this connection it is worth noting that Traill (1985: 112) reports burst spectra for bilabial clicks extending throughout the frequency range and being particularly strong in the 4 - 14 kHz range.

#### 3.6.4.3. Voicing characteristics

Garnes' results suggested that [kp] in Ibibio was distinguished from its simple



counterparts primarily with regard to voicing - first, in having a distinct ‘onset phase’ identified by the presence of voicing continuing into the closure (a positive VTT), and second, in that it had a voiced release. Measurements presented earlier (§3.4.4.2) are relevant to this discussion. For ease of reference, the overall means from the spectrographic study given in that section and based on utterances from 7 speakers (Table 3.4b) are repeated here in Table 3.6c, in comparison with those of Garnes.

	Garnes		this study	
	VTT	VOT	VTT	VOT
p	no value given		65.4 (35.7)	5.5 (7.1)
k	-	39	48.6 (29.4)	21.2 (13.0)
kp	60	- 22	50.4 (35.9)	-26.0 (16.0)

Table 3.6c: Comparison of values for VTT and VOT.  
Measurements are in ms, with standard deviations in parentheses.

It is clear from these results that [kp] is not distinguished from the simple stops by the presence of a distinct ‘onset phase’, as Garnes claimed. As these and other measurements show (Table 3.4c), this laryngeal activity is present for all voiceless stops and can be considered a relevant and interesting aspect of intervocalic stop production in Ibibio. In addition, the description Garnes gives of this phenomenon, “irregular, aperiodic low frequency vibrations which may be due to irregular vocal fold flaps”, (1975: 48) is appropriate for all stops in context of the spectrographic analysis, regardless of place of articulation. This appearance seems to be an artifact of the spectrogram. That is, when seen on the Lx record, the voicing tail is shown to be regular, though decreasing in both intensity and F0. The duration of the voicing tail is considerably variable, and in fact, not always present; but in other cases it may in fact carry on throughout the closure, to just before the release for [p] and [k], or to the onset of modal voicing for [kp]. It is also important to note that even when VTT extends throughout, or almost throughout, the closure, it is different from the voicing associated with [b] or any other truly voiced articulation in the language, as revealed by the laryngographic work reported earlier (§3.4; see also the discussion below on the EPG/Lx investigation). This difference is reflected in a reduction in amplitude of the Lx signal, which is likely indicative of incomplete closure of the vocal folds (cf. Baken 1987). Finally, it bears mentioning that the mean VTTs for [kp] and [k] are nearly identical.

The values found for VOT do coincide with those given by Garnes (the difference between her value for [k] and that found here is not outside the possible range of variation in the present study; she gives no value for [p]). Most important is the agreement in the presence of prevoicing for [kp], with the values from the two studies matching closely. This characteristic does indeed appear to be a defining feature of Ibibio [kp]. Despite this agreement, however, it should be noted that considerable variation does exist with regard to the duration of prevoicing. One speaker in my subject pool had a voice bar with a mean duration of 10.4 ms, and among his various productions of [kp] were a few tokens with 0 VOT (but never a delayed VOT), whereas the longest voice bar found was 80 ms (from a different speaker). Finally, it bears mentioning that the quality of voicing found in the voicebar is distinctly different from the voicing associated with VTT, as the Lx signal shows a marked increase in amplitude, very rapidly reaching that of modal voicing.

The spectrograms in Figure 3.6b, c, and d reflect the variation that is typical of the data. In particular, one might examine spectrograms of /ékpó/ and /íkpá/; in both cases, the total duration of the stop is about 100 ms. However, with respect to voice termination, in the case of /ékpó/, this is seen to continue throughout the closure until the resumption of modal voicing, a period of about 105 ms. For the other utterance, /íkpá/, voicing apparently ceases almost immediately - after 10 ms at most. The voice bar for /ékpó/ is about 55 ms in duration, and for /íkpá/, about 25 ms.

#### 3.6.4.4. Temporal aspects

A further disagreement with Garnes' results is found in the total durations of the stop closures. Duration measurements of these were reported in §3.4.4.2 (Table 3.4b), and are summarized here in terms of the overall means, against those of Garnes.

Total duration of stops		
	Garnes	this study
b	135	92.6 (21.2)
p	-	146.8 (29.0)
k	249	112.9 (28.5)
kp	261	162.4 (28.6)

Table 3.6d: Comparison of consonant durations. Measurements are in ms, with standard deviations in parentheses. Garnes gives no value for [p].

Two discrepancies are immediately apparent between Garnes' results and the present ones. Most noticeable are the much higher values Garnes obtained. Two factors might be assumed to contribute to this difference. First, Garnes' measurements are 'vowel-to-vowel', i.e., including VOT for the simple stops, whereas the present ones are exclusive of VOT for those stops. As adding the VOT value to the velar stop in the present study would not be enough to account for the differences, it can only be assumed that Garnes' speaker was using an exaggeratedly careful style. The second, and more interesting difference, however, is that Garnes finds durations for [k] and [kp] to be quite similar, which allows her to postulate that the labial-velar constitutes one unit of timing (p. 48). The total duration of [kp] was found here to be approximately 30% longer than that of [k], rather than virtually identical (and still over 20% longer if one includes the VOT for [k] in the measurement). An explanation for this difference is not readily apparent. Garnes used only one speaker in her study, and her results could be idiosyncratic, but on the other hand, the observed differential between [k] and [kp] in the present study was consistent across speakers (cf. Table 3.4b, above). The most plausible assumption, then, would be that Garnes' speaker did in fact use a very careful speaking style, as suggested, and that in addition to producing unnaturally long durations this also had the effect of reducing the durational differences between the two. The issue of whether [kp] constitutes one unit of timing is returned to briefly, in the conclusion to this section, below.

#### 3.6.4.5. Aerometry and laryngography

Subsequent to the recordings done in Calabar, it became possible to do further instrumental work in Edinburgh<sup>59</sup>. Airflow and laryngograph recordings were done to monitor oral and nasal airflow and laryngeal activity. This work was done using a different wordlist, containing 20 words (see Appendix C). For this, two native speakers recorded 8 repetitions of the list, one on three separate occasions, the other on one session only, in the phonetics laboratory at the University of Edinburgh. Three observations must be made initially concerning the interpretation of the airflow traces. First, the apparatus was not set up to allow for quantitative evaluation of pressure variations. Second, the filtering process used by the apparatus in processing the airflow signal introduces a delay of approximately 20 ms in that signal relative to the

<sup>59</sup> One of the reasons for undertaking the aerometric investigation was to attempt to discover the reason for the noise bands usually seen passing through the silent interval of stop articulations (see, e.g., Figs 3.6b, c, d). This problem remains unsolved; although the presence of the noise band suggests a leak somewhere during the closure, due to technical limitations this was not conclusively found.

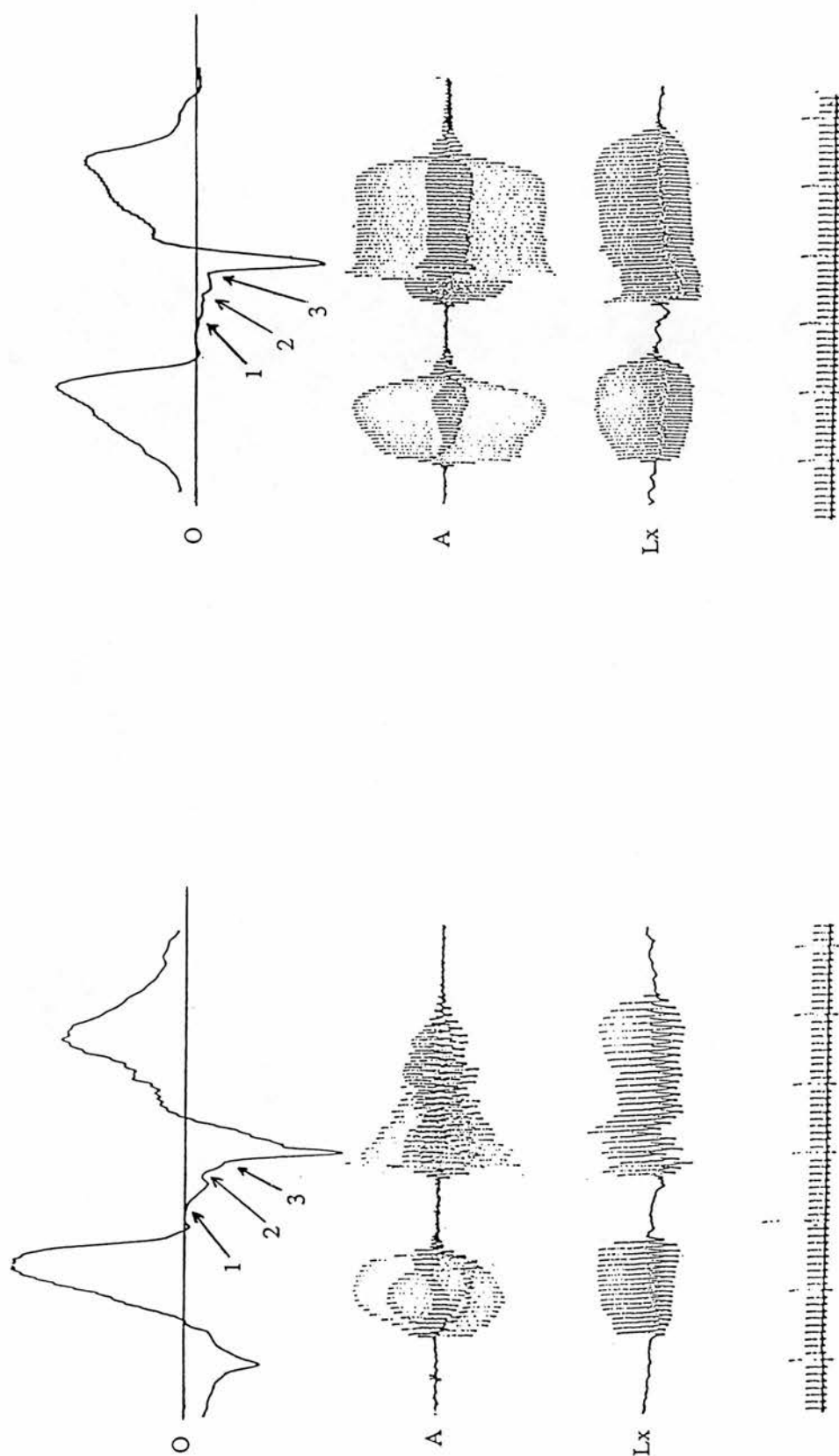


Fig.3.6e: Sample airflow records typical of Ibibio labial-velars. 'A' represents the audio signal, 'O' the oral airflow, and 'Lx' the output of the laryngograph. Points 1, 2, and 3 indicate landmarks in the airflow record. (Speaker B. Etuk.)

audio and Lx signals<sup>60</sup>; this was not known at the time of recording and so is not reflected in the output, and consequently quantitative evaluation of relative aspects of the timing of the various gestures involved (e.g., airflow vs voicing) is not presented; rather, a qualitative discussion is offered. Third, and of interest for the following discussion, the apparatus used is sufficiently sensitive to record variations in pressure that result from movements of the articulators during closure (Barry and Kuenzel 1975).

The oral airflow traces presented in Figure 3.6e are representative of those found for the Ibibio labial-velar. Three stages of descent are discernible in this signal, the beginnings of which are indicated by points 1, 2, and 3. Point 3 marks the beginning of a steep decline in the airflow trace, indicating a strong ingressive airflow; it is taken to reflect the release (i.e., the latter, labial release) of the stop. The change indicated at point 2, then, is taken to reflect the velar release, and the more shallow, but still noticeable, decline in the waveform beginning at 1 would reflect some other perturbation (discussed below) in the oral cavity prior to the two releases. If these judgements are correct, then the airflow record provides a convenient means of measuring the relative timing of the two releases, which is not possible with spectrograms. Interpreting these readings in light of the oral and pharyngeal pressure records made available to me by Peter Ladefoged lends support to this analysis, as demonstrated below.

Ladefoged's pressure records clearly show a decrease in oral pressure coinciding with an increase in pharyngeal pressure, confirming that a velaric airstream mechanism is employed<sup>61</sup>. They have been used here to examine three aspects of the temporal structure of the labial-velar: the duration of the velar closure relative to that of the entire stop, the relative timing of the two closures, and the timing of the decrease in oral pressure relative to the increase in pharyngeal pressure. Ladefoged's data include 42 tokens of labial-velars, 25 of which are oral (i.e., [kp] as opposed to [ɲm]), and it is these which are considered here.

For these, the velar element shows a mean closure duration of 72.8 ms (based on the duration of positive pharyngeal pressure) as compared to a total stop duration of 111.2 ms (based on the audio signal). These measurements concur with those given below in the EPG/Lx discussion. The pressure records also give a clear indication as

<sup>60</sup> This delay is not reflected in the alignment of the three waveforms for the utterances in Fig. 3.6e; the lower two, audio and Lx are aligned.

<sup>61</sup> For a description of Ladefoged's investigative technique, see Ladefoged 1964: 9.



to the relative timing of the two gestures. That is, if the labial closure were achieved prior to the velar closure, then the pressure records would show an increase in pressure in both cavities simultaneously, whereas if the velar closure were attained earlier (or if the two were simultaneous), then there would be no increase in oral pressure at all. It is this latter situation which obtains in Ladefoged's data, showing that the velar closure is never later than the labial one, at least for this speaker. As I did not have access to the actual tape recordings of these utterances, spectrograms could not be made to see whether the same variability in direction of F2 transitions as was discussed above also obtained for this speaker's utterances.

Ladefoged's records also allow for some insight into the nature of the production of the velaric airstream mechanism; first as to its timing. The decrease in oral pressure begins approximately 25 ms after the increase in pharyngeal pressure or, in other words, approximately 50 ms prior to the release of the velar closure. If this phenomenon is common across speakers, it can be argued that the onset of decrease in oral pressure corresponds to the decline in the oral airflow trace indicated at 1 in the utterances in Figure 3.6e, and may reflect either a backward movement of the dorso-velar contact, as is usually suggested for a velaric airstream mechanism, or a lowering of the front part of the tongue as Traill's (1985: 106) evidence shows. The EPG evidence brought to bear on this question below suggests the latter possibility is more probable.

The airflow/Lx investigation also confirms the existence of a voicing tail in all Ibibio stops, and the prevoicing which characterizes the labial-velar, as discussed in the spectrography section. As this work was also done in connection with the EPG analysis, it is returned to below.

#### 3.6.4.6. Electropalatography and laryngography

The electropalatographic investigation, combined with laryngography (and a time/amplitude waveform) allows for further conclusions to be drawn regarding the nature of [kp]. The EPG data provide information concerning the velar articulatory gesture itself, and also gives indication as to the relative timing of the labial and velar gestures when informed by the spectrographic findings. The laryngographic record not only confirmed the findings concerning VTT and VOT presented above based on spectrograph measurements, but can also shed some light as to the nature of the voicing involved, especially with regard to VTT. Both of these aspects have been discussed above in §3.4; results presented there are summarized here, bringing out

aspects relevant to the discussion of labial-velars.

The discussion in §3.5 revealed that the velar element of [kp] differs little from the simple velar [k] with regard to its articulatory gesture or place of contact. The contact did on occasion appear to be somewhat weaker than that for [k], and slightly shorter (cf. Tables 3.5f and 3.5g). Of greatest interest, though, was the lack of evidence for a backward movement of the contact area, as might be expected with the hypothesized velaric airstream (cf. Ladefoged's description, 1964: 12, which has become the standard one, or Pike 1943: 93ff)<sup>62</sup>. In fact, in some cases, a *forward* movement of the contact area was observed. This seemed largely dependent on vowel context (e.g. [akpi] would show a forward movement, but not [ikpa]), but not always, and it is worth noting that Houde 1968 (cited in Ohala 1983: 199ff.) found a forward motion involved in the articulation of English [k]. This motion, then, might well be a common aspect of velar articulations. EPG charts presented in Figure 3.6e for the sequences [VkpV] and [VkV] are typical of the similarity between the two velar articulations, and demonstrate that there is no detectable backward movement of the dorso-velar contact during the closure.

However, the aerometric analysis and Ladefoged's pressure records, as well as auditory impressions, clearly indicate the presence of an ingressive airflow that is at least in part initiated in the oral cavity. The gesture necessary to create this suction must therefore come from a lowering of the blade and front of the tongue, perhaps combined with a lowering of the jaw (though as mentioned, this jaw movement is not always readily observable for Ibibio). This is exactly the mechanism Traill (1985: 106) describes for the production of labial clicks in !Xóǀ as revealed by cineradiography, though he emphasizes that there is no lowering of the jaw involved in the production of any !Xóǀ clicks. Traill's X-ray tracings, however, sometimes indicate that the anterior part of the dorso-velar contact is lost during the lowering of the front part of the tongue, a movement<sup>which</sup> though slight, would almost certainly be reflected in the EPG record. Traill rightly denies that this is a relevant part of the creation of suction, as it does not constitute a downward and backward movement of the dorso-velar closure.

The EPG investigation allowed for an evaluation of the relative duration of the

---

<sup>62</sup> It might be argued that as the EPG technique does not allow for complete coverage of the velum, the backward movement might not be registered. At least in tokens of [ikpi], however, it was clear that enough (and in some tokens all) of the contact area was registered to allow this conclusion to be drawn with confidence.

two closures by comparing the period of closure as shown for the velar contact on the EPG charts with the period of closure for the entire stop (vowel-to-vowel) as indicated by the associated time/amp waveforms. In this regard, a considerable difference was found between means for the duration of the velar closure (71.5 ms) and the total duration of the stop (127.2 ms)<sup>63</sup>, clear evidence that an asynchrony exists for the timing of the two gestures. Given the evidence from spectrography, that suggests there is greater synchrony between the two closures than between the two releases (i.e., the variability in F2 transitions for the closure compared to the more or less consistent labial-like ones for the release), we can assume the velar release occurs approximately 30 - 50 ms before the labial release. This also tallies, roughly, with the airflow record, and indications gleaned from Ladefoged's pressure recordings. It also bears mentioning that the mean duration found for the velar element of [kp] is almost identical to that of [k] (71.5 ms and 74.6 ms respectively) for the same speaker - further evidence perhaps that there is essentially no difference between the two articulations. On the other hand, it must be pointed out that the velar element of [kp] did appear to be more prone to having what seemed to be an incomplete closure, though this could well have been due to position in the word (cf. the discussion in 3.5.4), rather than an inherent weakness of the velar element of this stop.

The results of the Lx analysis concerning VTT and VOT were presented in §3.4.4.2, and are summarized here, in Table 3.6e. These results confirm those of the spectrographic analysis, that a voice termination time is a relevant part of the production of all stops in Ibibio (not merely [kp]), and that the prevoicing found for [kp] is indeed a characteristic feature of that consonant.

	VTT	VOT
k	29.3 (31.1)	31.8 (23.2)
kp	19.2 (12.4)	-41.2 (15.2)

Table 3.6e: Comparison of VTT and VOT values for [k] and [kp] based on EPG/Lx analysis. Values are in milliseconds, with standard deviations in parentheses.

A second point which can be made concerns the nature of the vocal fold activity. My own analysis of VTT based on spectrography confirmed Garnes'

<sup>63</sup> This value is considerable lower than the mean duration for [kp] arrived at in the spectrographic study (162.4 ms), but it is still within the range of cross-speaker variation found. Cf. Table 3.3.b.

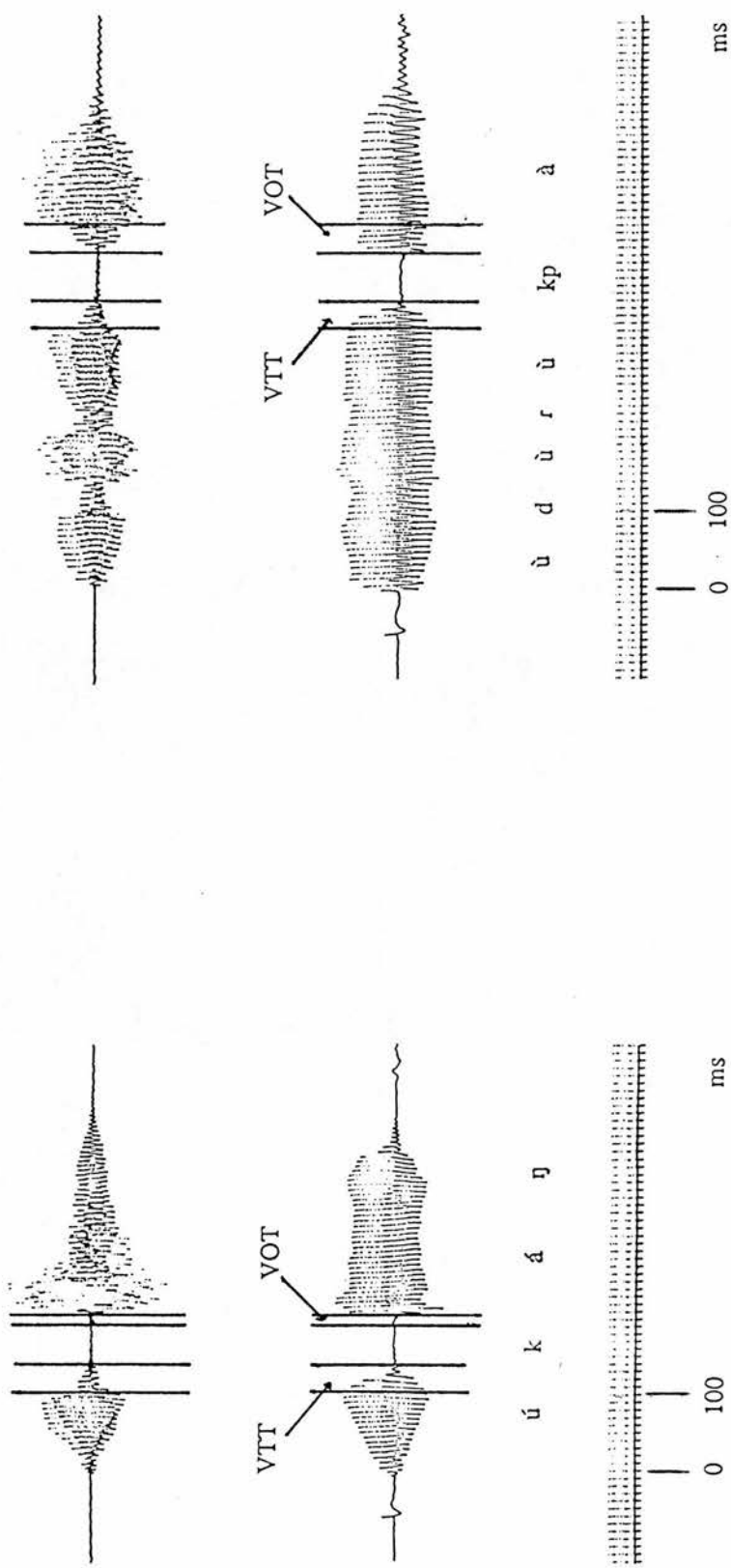


Fig. 3.6f: Comparison of voicing characteristics of Ibibio [k] (from úkán ‘charcoal’) and [kp] (from ùdùrùkpà ‘tug of war’).

qualitative description (i.e., “irregular, aperiodic low frequency vibrations which may be due to irregular vocal fold flaps”) ; however, work with the laryngograph, which gives a more direct representation of the vocal fold activity shows the vocal fold vibrations during VTT to be neither irregular nor aperiodic, although the frequency and intensity of vibration does taper off as voicing becomes curtailed. Figure 3.6f shows the Lx record together with the audio waveform for the utterances [VkpV] and [VkV], demonstrating the differences in phonation associated both between VTT voicing and the prevoicing of the labial-velar, as well as the difference between the onset of voicing for [kpV] (i.e., the prevoicing) and the onset of voicing associated with a post-consonantal vowel ([kV]).

### 3.6.5. Summary and conclusions

The combined use of different instrumental techniques has proved revealing with regard to determining the structure of the Ibibio labial-velar stop. It is apparent that the two articulations are not simultaneous as is usually claimed for labial-velar stops (if by ‘simultaneous’ total synchrony is implied, as in Westermann and Ward 1933), but rather, that the timing relations between the two are both staggered and variable. A descriptive summary of events involved in the production of the Ibibio labial-velar are given below and are represented schematically in Fig. 3.6g.

The velar closure and the labial one appear to be fairly closely synchronized, but with the velar closure normally preceding the labial one by approximately 20 ms. It may, however, be possible that for some speakers, on some occasions, the labial closure may precede the velar one, as suggested by variation in F2 transitions. This variation may be speaker dependant, but there is some indication in the data presented here that it could in fact be dialectal within Ibibio. Subsequent to the two closures, the sequence of events may be described as follows. Approximately 25 ms after the closures the front part of the tongue is lowered (and, in addition, perhaps the mandible), rarifying the air in the oral cavity, and initiating what has been somewhat inappropriately termed a velaric airstream mechanism. (A more accurate term would be, following Pike 1943: 93ff, ‘oral airstream mechanism’<sup>64</sup>). About 50 ms after this lowering, the dorso-velar closure is released, and about 10 - 20 ms subsequent to this, voicing begins. Approximately 40 ms later, the labial closure is released and vowel onset begins.

---

<sup>64</sup> Another alternative would be to refer to these stops as ‘suction-initiated’ (Catford 1977: 63ff). This alternative is less preferable because, as Catford points out, it is not only tongue action that can create suction in speech sounds.



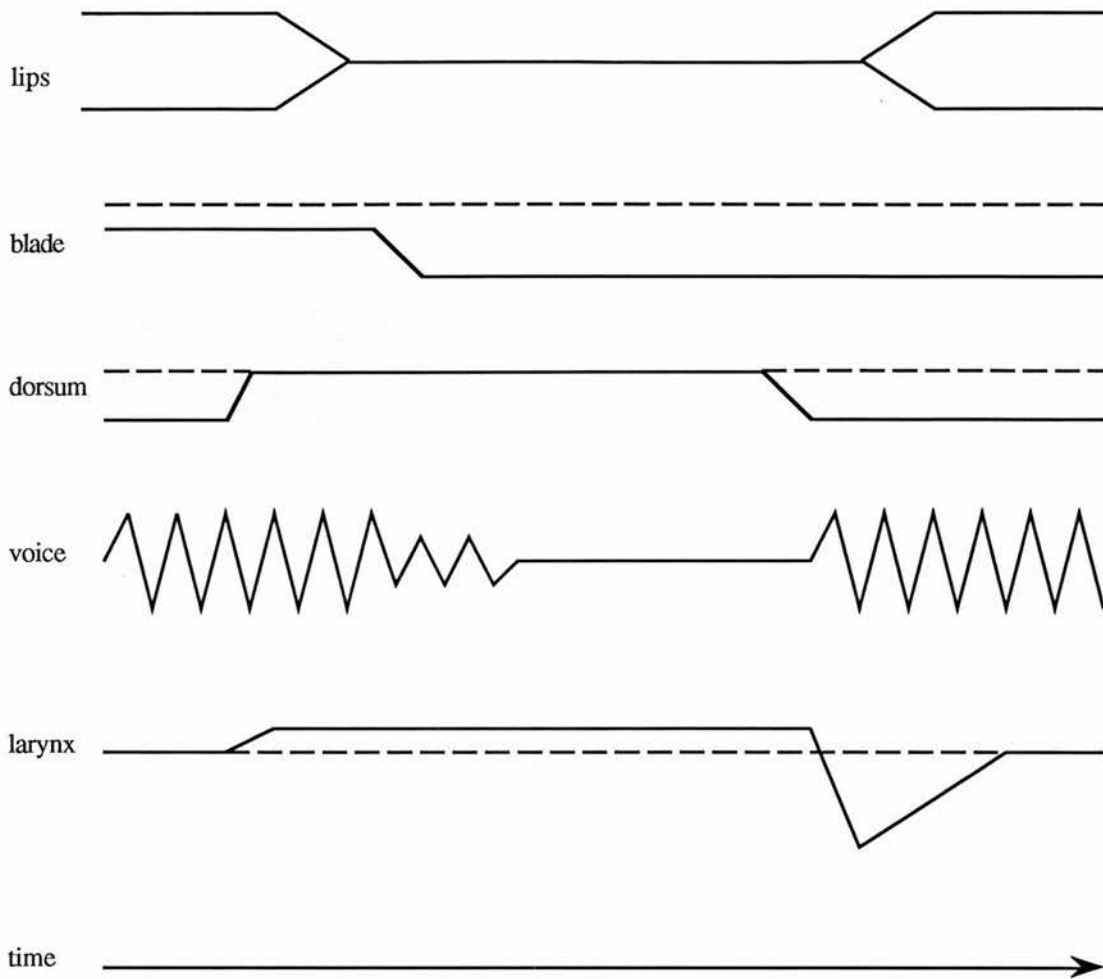


Fig. 3.6g: Schematic parametric representation of articulatory gestures involved in the production of Ibibio /kp/.

There are some indications that a downward movement of the larynx may also be employed, and that this is associated with the onset of voicing. First, it will be recalled that Ladefoged (1964: 10, Table 3) relates 'part voiced' stops to his type 3 - those which also involve a glottalic airstream mechanism. One would normally expect a decrease in pharyngeal pressure to accompany this action, which Ladefoged shows for other languages (e.g., Bini) in which this is involved. This decrease does not appear to be present in Ladefoged's pressure records for Ibibio. However, if the onset of voicing is associated with the glottalic mechanism, then the expected pressure drop

could possibly be neutralized. As mentioned earlier, a downward displacement of the larynx is, at least on occasion, quite noticeable for at least some Ibibio speakers, and was also sometimes registered by the Gx function of the laryngograph<sup>65</sup>. A downward movement of the glottis would be seen, then, not as an airstream mechanism in the strict sense of the term, but rather as a mechanism for inducing voicing. Given the overall variability of the production of labial-velar stops, both within and across speakers, it is not unreasonable to suggest that this third mechanism may be employed, but not for all speakers nor necessarily at all times for those who do use it. Those speakers with a shorter voice-bar may not employ it to the same extent as those with longer voice-bars (e.g., speakers DE and II or PN, Table 3.4b).

The spectral characteristics of the Ibibio labial-velar were found to concur in large measure with what has been reported for other labial-velars. In particular, this was true of the nature of the transition for F2 on release, which appeared to have a lower locus than what is normally obtained for simple labials, as well as appearing to be steeper and stronger. Nevertheless, the search for invariant acoustic cues for place of articulation must be undertaken with caution with regard to these stops. The amount of variability found in the production of labial-velars across languages, especially concerning the timing relations between the two articulations, suggests that spectral characteristics, and hence acoustic cues, would vary accordingly.

On a number of occasions in the preceding discussion, reference has been made to the articulation of labial clicks and possible similarities between these and labial-velar stops. There do indeed appear to be similarities, particularly in that the airstream mechanism described by Traill for clicks seems to be what is employed for Ibibio labial-velars. There are clear auditory differences between the two, however, and these are perhaps due mainly to the variable timing relations for the labial-velar which, at least by Traill's description, do not enter into the picture in the production of the labial click. The two articulations involved in its production do indeed seem to be simultaneous.

Passing reference was also made to possible similarities between the labial-velar of Ibibio, and that of Yoruba. In particular, it was claimed that the two are not as similar as Ladefoged (1964) suggested. There appear to be two basic differences

---

<sup>65</sup> The Gx function on the laryngograph was considered unreliable (S. Smith, personal communication) and was subsequently abandoned after a trial run. It is not clear whether the inconsistency in registering a downward movement of the larynx was an artifact of this unreliability, or if in fact it was not always present.

between the two. The first is the use of a glottalic ingressive airstream mechanism in Ibibio, resulting in the prevoicing found there, and which (by both Ladefoged's and my own preliminary analysis of Yoruba labial-velars) seems not to be present in Yoruba. The second is the possibility of a substantially earlier labial closure in Yoruba, as suggested by Painter's work, which does not occur in Ibibio. Both of these await further work for confirmation.

Also, it was mentioned in the introduction to this section that the phonetic facts of labial-velars as presented here are considered important for an adequate phonological account of labial-velars. This is particularly relevant for theories of phonology concerned with the internal structure of the segment (e.g. feature geometry). Detailed discussion of these issues is beyond the scope of the present work, but at least a hint may be given here. Garnes' (1975) discussion of the Ibibio labial-velar, and particularly her claim that it constituted one unit of timing, formed part of the basis of Sagey's (1986) discussion of complex segments. Both my own data and those of Ladefoged discussed here contradict the claim that [kp] and [k] have virtually identical durations, which was the basis of Garnes' assertion. A good candidate for 'one unit of timing' would be a sound (double stop in this case) in which both components had approximately the same duration, regardless whether or not an asynchrony existed. The asynchrony would then have to be shown to be a result of biomechanical factors if the one timing unit hypothesis were to hold. In the Ibibio case, the velar component resembles the simple velar in all important respects, including duration, and the labial element, with regard to duration, at least, resembles the simple labial stop [p]<sup>66</sup>. The difference in durations for the labial and velar elements, as revealed not only for Ibibio, but also by Painter (1978) for Gã and Yoruba, together with the variability found in the production of these stops across languages, gives cause to think of the implications this might present for phonological theory, particularly regarding the feasibility of making generalizations of the sort presented by Sagey.

Finally, the structure of the Ibibio labial-velar stop as revealed in this section has clear implications for understanding the developments of the labial-velar of proto-Lower Cross, which exhibits a number of different reflexes across the group. These implications are discussed in depth in Chapter 5, together with a suggestion as to how the observation of Westermann and Ward (1933), mentioned at the outset of this

---

<sup>66</sup> This statement may be slightly misleading. It should be remembered that, strictly speaking, in Ibibio, [kp] and [p] may not be comparable for, as indicated in Chap. 2, with a few exceptions they occur in different places in the word.

section, that for labial-velars undergoing sound change it is usually the velar element which survives, may be reconciled with the fact that in many cases (e.g., Lower Cross), it is the labial element which prevails.

### **3.7. Phonetic Characteristics of the Consonants of the Lower Cross Languages**

#### **3.7.1. Introduction**

The previous sections of this chapter have presented a description of the consonants of Ibibio, primarily through use of various instrumental phonetic techniques. In this section, characteristics of the consonants of the Lower Cross languages generally are presented, with reference to what is now known about Ibibio. It would obviously be an immense task to attempt a similar treatment for each of the other 18 languages under consideration, and desirable though this might be, such an undertaking is well beyond the scope of this dissertation. In any event, speakers of the other languages were not available for the same kind of instrumental analyses as were done with Ibibio. In some instances, recourse can and will be made to spectrographic evidence, as tape recorded material from each of the languages exists<sup>67</sup>. In general, these recordings were not made with a view to experimental work, and evidence derived from them is purely illustrative. For the most part, the description to follow is straightforwardly impressionistic.

Generally speaking, with regard to consonant systems, there is a high degree of phonetic similarity among the languages of the group. Therefore, rather than examining each of the languages one by one, which would introduce a great deal of repetition, the discussion will proceed following the pattern established in §3.2, i.e., in terms of place of articulation. This is done first for consonants as they occur in initial position<sup>68</sup>; subsequently, ambisyllabic and final realizations will be treated, and in a separate subsection I will also discuss certain variations in voicing characteristics.

For reasons presented in the Introduction, varying degrees of familiarity have been achieved with the different languages. Because of this, varying degrees of attention have been accorded here to the different languages; in particular Efik and Oro, having received prior treatment by other writers (cf. Chapter Two), receive somewhat more attention than the others. My own data collection also allows for greater

<sup>67</sup> Spectrograms for Efik were made from tapes provided by T.L. Cook, and recorded in the Phonetics Laboratory at the University of Leiden, as these were of better quality than my own field recordings.

<sup>68</sup> In Chapter Two two types of 'initial' position were distinguished, post-pausal, or 'absolute' initial, and initial position which is nevertheless intervocalic.

discussion of these, as well as Anaang, Ekit and Usakade; however no language, is ignored.

Finally, in reading this section it will be recalled that in Chapter Two phonemic inventories of the consonant system of each of the languages were presented. It is not the intention in this section to duplicate the work of that chapter, so consequently little reference will be made to questions of phonemic status or other phonological considerations. The main aim of the section is to present variations in phonetic realization of consonants across the group that might be of interest later, in discussing sound change.

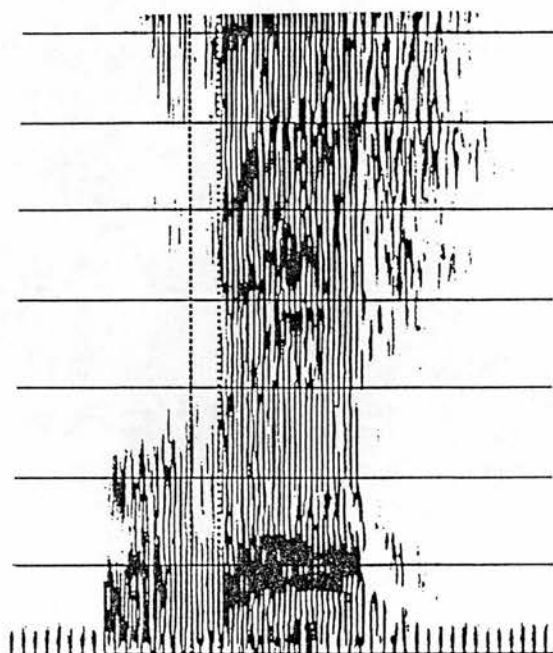
### 3.7.2. Labials

[p]: Labial stops, both voiced and voiceless, are found throughout the group, though the distribution of [p] is variable. In those languages where its distribution is similar to that of Ibibio (i.e., essentially occurring only pre-pausally) this stop is normally voiceless, and unreleased. However, in those languages where [p] also occurs in initial position, i.e., Anaang (Ikot Ekpene dialect), Ebughu, Enwang, ItuMbuso, Okobo, and Uda, as a reflex of PLC \*kp<sup>69</sup>, its realization is variable, with regard to the laryngeal gesture. In most cases it is voiceless unaspirated [p], however in Ebughu and Enwang it is sometimes somewhat aspirated [p<sup>h</sup>], and in ItuMbuso, a pre-glottalized variant [ʔp] has been heard to occur. Further discussion of this is given in Chapter Five, but I note here that of these languages, ItuMbuso and Uda have not lost [kp] completely. In Ibino, [p] and [p<sup>h</sup>] also occur in initial position as reflexes of PLC \*b, though at this point it is not clear whether this variation is conditioned or free.

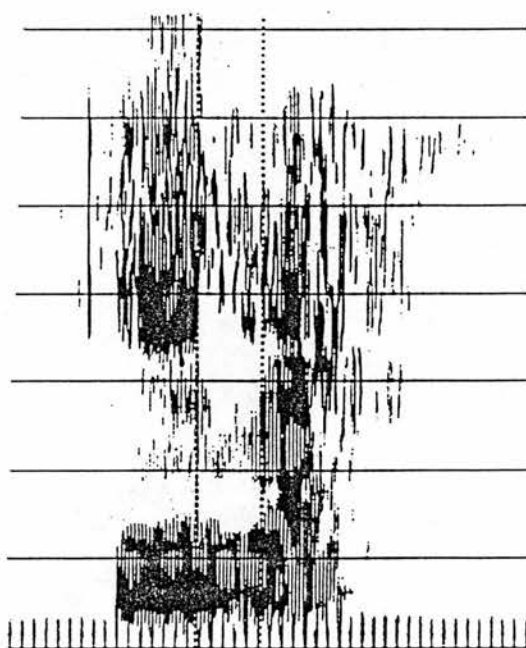
[b]: In initial position throughout the group, [b] is normally a fully voiced stop, although in most of the group (i.e., except in Efik, Ekit, and Ukwá, as well as some dialects of Ibibio) it also has variable realizations. These additional realizations are essentially the same as those described earlier for /b/ in ambisyllabic position, that is, either a tapped labial stop or fricative is possible. Spectrographic evidence for these from Ibibio is given in Fig. 3.7a, compared to the full [β], a reflex of PLC \*b, found in Usakade. The shorter duration of the Ibibio tapped fricative, at 47 ms, is readily apparent relative to the fully realized fricative of Usakade (109 ms). In other cases, the possible variation, or development of [b], extends to [w], e.g., dialectally in Ibibio 'head' /íwùùd ~ íbùùd/, and Anaang /íwòd ~ íbòd/.

<sup>69</sup> Justification for the reconstruction is given in Chapter Four.





[ùβè:t̚] (Ibibio)



[éβá] Usakade

Figure 3.7a: Spectrograms of Ibibio ùbèèd [ùβè:t̚] 'room' and Usakade [éβá] 'breast', demonstrating tapped fricative realization of /b/ compared to [β] (untapped or full fricative) as found in Usakade. The tapped realization of Ibibio /b/, indicated by the cursors, is 47 ms, while Usakade /β/ is 109 ms. The vertical scale gives frequency in steps of 500Hz. (Speakers: E.E. Akpan, Ibibio; C.E. Motina, Usakade.)

This trend towards reduction of [b] has been defied (in fact the opposite occurs) in two languages. In Ebughu, in addition to [b] and weakened varieties of [b], we also find a few instances of [gb] corresponding to [b] elsewhere, for example 'goat', [égbó] (PLC \*ébót), and in Ibino, as mentioned above, a historical devoicing process has apparently occurred (although not completely).

In summary, although a voiced labial stop is still common throughout the group, there is at the same time a tendency towards the reduction of this articulation in most Lower Cross languages. This can be seen as both a synchronic and diachronic phenomenon, affecting the different languages to varying degrees; e.g., in Anaang, Obolo, Oro, Enwang, Uda, and Usakade its effects have been different (though all show fricatives corresponding to the stop elsewhere), but stronger than in other languages of the group.

[m]: A labial nasal stop occurs throughout the group, with no appreciable variation in its production. It is perhaps worth noting here though, that [m] has the effect of stabilizing the following consonant, preventing its reduction, e.g., in Usakade, /b/ and /β/ occur intervocally (initially), but only [b] occurs after [m]; úβo / míbo 'head/s', or míbíríβi, 'grass' (a reduplicated form). Ohala (1980: 82) examines briefly a similar phenomenon in Bantu, suggesting it to be a 'strategy' for the maintenance of voicing.

### 3.7.3. Labiodentals

[f], [v]: The voiceless labiodental fricative [f] is found throughout the group without noticeable variation in articulation. Although in both Obolo and Oro, [f] is found corresponding to [b] elsewhere in the group, generally speaking instances of [f] can be traced back to the parent language. The same cannot be said of the voiced labiodental fricative [v]. Instances of this occur in Enwang and Uda corresponding to [b] elsewhere, while in Ebughu and Oro [v] occurs seemingly in 'free variation' with [f] (see §3.7.9, below, on voicing characteristics). Apart from in these four languages, [v] is not found in the group.

[ɱ]: A labiodental nasal [ɱ] is often used homorganically, preceding [f], although it would be more appropriately described as a nasal labiodental fricative, rather than the stop that the symbol suggests. Perhaps more often, however, this 'homorganic' nasal is realized as [m]. It has not been possible to ascertain the reason underlying the variation, though speech rate and style can be suggested as likely candidates, or indeed it may even be idiolectal.

### 3.7.4. Alveolars

[t]: The voiceless alveolar stop [t] of Ibibio was described in §3.2 as being ‘denti-post-alveolar’ in terms of its linguo-palatal contact pattern, and in §3.5 dynamic palatography revealed clear evidence as to the nature of the linguo-palatal contact which gives rise to the affrication heard, particularly when this consonant is followed by [i]. This same process of affrication occurs throughout the group; a description of Efik alveolars from Ward (1933: 6) gives her interpretation:

The plosives **t** and **d** are vigorously articulated and somewhat palatalized ...[which]... results in a kind of **y**-glide when the stop is released; when the vowels **i** and **u** follow, the glide is not very noticeable, but when **e**, **a**, or **ɔ** follow, this glide is distinctly heard: **dep** sounds almost like **dyeəp**. In intervocalic positions also, **t** is somewhat affricated, particularly when **i** and **u** follow. (Ward 1933: 6)

Cook (1969a, 1969b) generally seems to concur with Ward’s description, though in this case he denies (1969a: 22) that there is palatalization (or a “y-offglide”) for most speakers, and also seems to discount the possibility of affrication in the case of following [i] or [u]. This, however, does seem to be clearly audible for most Efik speakers; Fig 3.7b gives a spectrographic representation of the affrication in Efik<sup>70</sup>. He comments on what he finds to be a large area of contact for [t], describing the effect of this as being a “sticky” or “heavy” sound (i.e., the release) which is more noticeable before /ɛ/, /a/, /ɔ/, and /o/. He also points out that the effect of this characteristic is apparently variable across speakers. Despite impressionistic interpretations being somewhat different, then, the description that these two scholars give for Efik [t] to some extent confirms and is consistent with what the instrumental analysis revealed for Ibibio. While Ibibio [t] is ‘vigorously’ articulated in all environments, there is no suggestion of palatalization (or ‘heaviness’) for [t] in a low vowel environment - nor has this been particularly noticeable for any Efik speakers I have worked with. What is most salient for both Efik and Ibibio [t] is the affrication (assibilation) when followed by [i]. A similar effect is present when followed by [u], but in this case it is less strong, and tends more towards palatalization than assibilation.

In the rest of the group, the patterns observed for Ibibio and Efik seem generally to hold true. First, [t] is strongly articulated throughout the group. The phenomenon of affrication noted particularly in instances of /-ti-/ ([tʰi]) occurs to a greater or lesser extent in all Lower Cross languages. This, then, suggests that the denti-post-alveolar articulation demonstrated for Ibibio [t] is common throughout the

<sup>70</sup> As this utterance is taken from running speech, final /d/ of *ítíád* is voiced, as it is not pre-pausal.

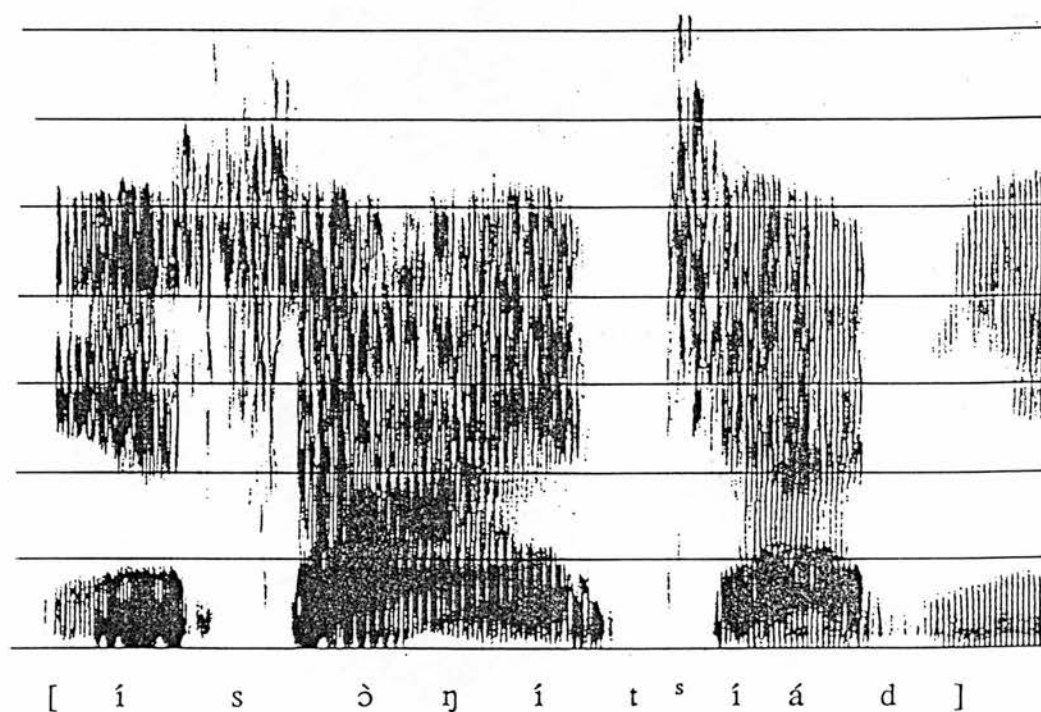


Figure 3.7b: Spectrogram of *ísòṅ ítíád* [ísòṅ ít<sup>s</sup>íád] demonstrating affrication of /t/ in Efik. The spectral characteristics of the release of /t/ may be compared with /s/ of *ísòṅ*. Frequency scale is in 1kHz steps. (Extracted from a text of running speech; Speaker: Grace Arit Ibanga Inyang-Brassem. Recording provided by T.L. Cook.)

group. For Oro, Kuperus (1978) describes /t/ in initial position as being unaspirated or lightly aspirated, and having no other allophones. However, what she heard as light aspiration must almost certainly be affrication; in Oro this is relatively strong when [t] is followed by a high vowel, and less so when followed by a mid vowel; only [t] followed by [a] seems always to be free of affrication, though even in this case the consonant is still heard as being strongly or vigorously articulated.

For Ibibio, it was also pointed out earlier that although auditorily assibilation is noticeable, the EPG evidence also suggested a fair degree of palatalization (see §3.5, and Fig. 3.51). This tendency may be reflected in what could be analyzed diachronically as an intrusive high front vowel in certain languages of the group, e.g., 'tree' (PLC \*étó): Etebi, Ibino, Iko, [ítʰìò], Obolo [úfìè], Ebughu [áítʰíé ~ áífʰíé]; 'father' (PLC \*èté): Ebughu [ètʰíé], Efai [ètʰíé]; 'saliva' (PLC \*étáp): Ilue [étjé]. An alternative hypothesis is that the high front vowel is to be reconstructed (i.e., PLC \*etíó), though the reconstructed form \*étáp for 'saliva' (\*etíáp being much less probable) would seem to argue against this.

[d] ~ [r] ~ [ɹ]: The evidence for Ibibio [d] differs substantially from the assessments given by Ward and Cook for Efik [d]. As indicated by the quotation from Ward above, she considered the articulatory characteristics of [t] and [d] to be essentially the same; Cook discusses the two consonants separately, but still argues (1969a: 33) that [d] involves the same large contact area as [t], and is characterized by the same 'heavy' auditory quality (although again he points out that this is variable across speakers). Recalling the EPG evidence from Ibibio, this would then suggest a considerable difference in articulation between Efik and Ibibio. By my own evaluation, it seems to be the case that, like that of Ibibio, Efik [d] is in fact a lighter articulation than [t], in normal conversational circumstances. One does on occasion hear the y-offglide referred to by Ward (with following [e] or [u], primarily; in fact [d] can have the effect of substantially fronting a following [u], to [ʉ], in both Efik and Ibibio) or the 'heaviness' referred to by Cook (mainly with [ɔ]), but generally not. For Efik, as for Ibibio, speech rate and style seem to play a role in determining the realization of [d] (to a greater extent than for [t]). In noting differences between Ward, Cook and my own findings for Efik, two other points should be borne in mind. First, as Cook points out, a certain amount of variability exists across speakers; second, and of unknown importance given the limited number of speakers used, is that three different generations of Efik speakers have been examined (and possibly spanning 4 generations), and the differences observed could well represent changes that have



occurred over time.

The voiced alveolar stop in most languages of the group, then, is assumed to have articulatory characteristics similar to those described for Ibibio. This conclusion is based on the fact that throughout the group the tendency exists for this stop to undergo the same kind of reduction as that described dialectally for Ibibio. In almost all languages of the group there are at least some words where /d/ is normally realized as [r], though the tendency is more widespread in some than in others. In the Abak dialect of Anaang, a change of [d] to [r] is almost total, and the tapped realization has become phonologized. Other than this, Ebughu, Enwang, Iko, Okobo, and Uda demonstrate a reduction of [d] to [r] to perhaps the greatest extent, while in Ibino, Ibuoro, Ilue, ItuMbuso, and Usakade, this reduction is not quite as extensive. Efai, Ekit, Etebi, Oro, and Ukwá show the lowest occurrence of [r].

In those languages where [d] does tend to reduce to [r], it is difficult in some cases to distinguish whether it is one or the other sound which is being heard. There is, in effect, an auditory merger of the two sounds. The difference between the two is not simply one of length, but also, and perhaps more crucially, one of degree of contact (cf. §3.2.3). This situation is particularly evident in Enwang where, in doing transcription, the tendency in ambiguous cases was to opt for [d], but in Iko, [r] tended to predominate. It is possible that while duration of the gesture in both cases was similar, in Enwang slightly greater contact is achieved. In Oro, only in the environment [a\_a] is there any inclination to transcribe [r], rather than [d], suggesting that the development may be to a certain extent environmentally conditioned. The tendency for reduction and auditory ambiguity go a step further in Ebughu, Okobo, and Uda where instances of [ɹ] have also been recorded occurring in initial position, and there are cases where it is difficult to discern whether one is hearing [r] or [ɹ], the impression being one of hearing both sounds simultaneously. This phenomenon is interesting from the standpoint of sound change, and is returned to in Chapter 5.

In Efik there are also instances of [ɹ], however, these seem in part to be due to an orthographic influence, as it appears to occur only in words that are spelled with 'r', and of these, only a subset; e.g., *eririmbot*, 'world', is [ɛ̀rɛ́.ɹím̀bòt̃ ~ ɛ̀dɛ́.ɹím̀bòt̃ ~ ɛ̀.ɹím̀bòt̃]. This variant of [ɹ] also has a different auditory quality, in that it is clearly an alveolar approximant, very closely resembling that found in standard British English, and never to be confused with [r]. Therefore one might also only expect to find this in relatively well educated Efik speakers.

In addition to Abak Anaang, Obolo also has an 'r'-phoneme, realized sometimes as [r], and other times as [ɹ]. The basis of the variation is not entirely clear, but certainly [ɹ] does not occur in (absolute) initial position (i.e., post-pausally), while the tap may occur in (absolute) initial position as well as intervocalic position. The situation in Obolo, however, is different from that in the other languages, as here [r] or [ɹ] is not so obviously to be seen as being related to [d]. This issue, too, is explored in greater depth in the following chapters.

Finally, one other characteristic of [r] in Lower Cross as it occurs in initial position, is a tendency for it to strengthen to a voiced apical trill [r̥] in certain apparently transparent situations; i.e., those involving emphatic or excited speech, or on occasion when a more careful speech register is being used (such as that sometimes adopted for reading wordlists to a researcher).

[n]: A voiced alveolar nasal stop occurs throughout the group, and as with [m], it does not demonstrate any appreciable variation in its articulation; it is assumed that the characteristics demonstrated for Ibibio [n] through the EPG analysis reflects its production in the rest of the group.

[s]: The voiceless alveolar fricative [s] is found throughout the group with relatively little variation. There is a tendency for it to palatalize when followed by [i], or, somewhat less so, with [u]. Though this tendency exists across the group, it is perhaps most noticeable in ItuMbuso, with pronunciations such as [ísʃèk̚] /ísèk/ 'fat', and in Efai. The palatalizing effect is not surprising when seen in the light of the EPG work done on Ibibio, which showed greater contact of the tongue rims and dorsum for [s] followed by [i] and [u], which in particular resulted a high degree of similarity in contact pattern for [s] and [i], and difficulty in segmenting these two sounds on the EPG charts when found in sequence. The palatalization may also be reflected in a phenomenon similar to that mentioned above for [t]: the existence of what is possibly an intrusive high front vowel in certain words. This can be seen, for example in variations in the pronunciation of Efik 'cooking pot', [èšìò] or [èsò], which is possibly a generational difference (E.B. Ekeng, personal communication), or in differences in pronunciation of 'face' as manifested across the group: e.g. Efik [ísó], Etebi [ísíó], Ekit [ísí]. There are other instances of apparent historical palatalization of [s], which turn up primarily in Obolo, and dialectally in Anaang and which also involve hardening; these are occurrences of a palato-alveolar affricate; voiceless in Anaang, e.g. [ítʃòŋ] 'ground' or [tʃák], 'laugh', and voiced or voiceless in Obolo, e.g. [ídʒòŋ] and [tʃák].

In my data, the affricate normally occurs only when followed by a low vowel<sup>71</sup>, and it is not immediately certain whether these actually are cases of the affrication having developed, or whether these occurrences represent a retention from an earlier stage of development.

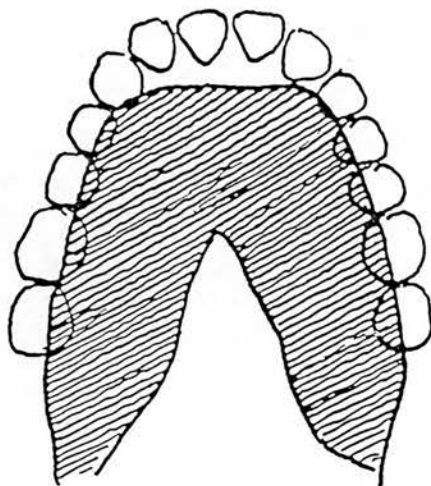
### 3.7.5. Palatals

[j]: An oral and a nasal palatal consonant occur throughout Lower Cross, /j/ and /ɲ/<sup>72</sup>, though across the group there is considerably more phonetic variation in the oral one than in its nasal counterpart. The voiced oral approximant in Efik is described by Cook (1969a: 58) as being “pronounced more tensely and forcefully than its English counterpart”. Throughout Lower Cross, this description could be accepted as appropriate, noting that the greater tenseness and forcefulness observed by Cook in fact results in a closer articulation. In other words, it is more accurate to refer to this sound as a fricative, [j̥]. For many Ibibio speakers, in emphatic or excited speech, this sound may be realized as an affricate: [dʒ] or [dʒ̥] e.g. ‘drop (it)!’, jàxn̩m! [j̥-àɣn̩m] ~ [dʒàkn̩m] ~ [dʒàgn̩m] (note, however, that when this sound is found in non-initial position, as in Ibibio dáyá ‘sleep’, it is more often realized as a true approximant, and less likely to undergo the affrication process). It is not known how widespread this emphatic speech phenomenon is, but in dialects spoken in the south of the Ibibio area, as well as for some dialects of Anaang, most Ekit, Ebughu, and many Oro speakers, it is in fact the affricate which is the normal realization. In Abak and Ukanafun Anaang, [dʒ] and [dʒ̥] are most common, and [j̥] also appears in normal speech styles. In Ibino, the voiceless affricate [tʃ] corresponds to [j̥, dʒ] as found elsewhere. The approximant is rare, and when it does occur it does not correspond to [j] elsewhere in the group. A similar situation obtains in Iko, but with [z] being the realization, rather than [j] or either of the affricates. Obolo has [dʒ] corresponding to [j], [dʒ], and [dʒ̥], but also [d] and [s] elsewhere in the group (cf. above).

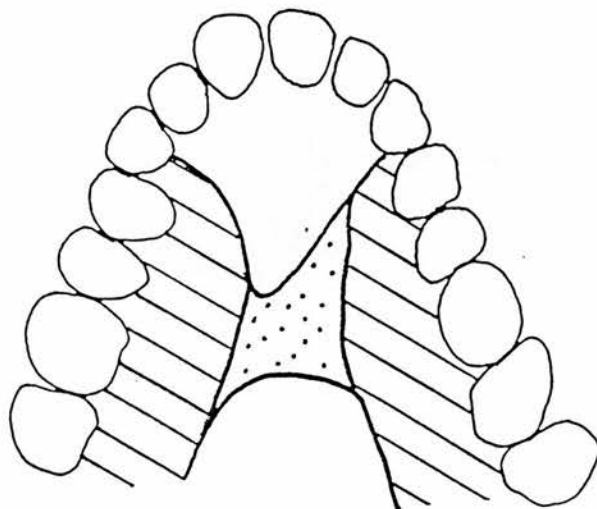
[ɲ]: The palatal nasal [ɲ] also demonstrates a certain amount of variation across the group, and again the variation seen in Ibibio as revealed by the EPG examination can be considered to reflect that found across the group. For Efik, Cook describes [ɲ] as being essentially the same as that found in Spanish or French; it seems the basic point he wants to make is that this is a true palatal, rather than a sequence of [nj]. Given this comparison, it is worth examining briefly the nature of the palatal nasal in French and

<sup>71</sup> It (i.e., [tʃ]) also occurs in Obolo, Usakade, and especially Ibino in non-low vowel contexts, but in these instances, it does not correspond to [s] elsewhere.

<sup>72</sup> This is not meant to suggest that this (/j/, /ɲ/) is an appropriate phonemicization for the whole group. Obolo, for example clearly has /dʒ/ (see Chap. 2).



(a) French [ɲ] from 'agneau' [aɲo]



(b) Ibibio [ɲ] from [aɲa]

Figure 3.7c: Palatograms of [ɲ] in (a) French 'agneau' (Straka 1968: 35), and (b) Ibibio [aɲa], (composite based on 8 tokens - see §3.5), showing differing places of articulation for palatals.

other Romance languages. Passy (1914: 75) makes the point that there is considerable variation in French [ɲ] as to its articulation, both with regard to the degree of closure and precise location of the contact, claiming, in fact, that both [j] and [nj] are not uncommon realizations of this sound in French. Palatograms of French [ɲ] show clearly that its articulation is alveolopalatal (e.g., Straka 1965); similar findings have been presented or referred to by Recasens for Catalan and other languages such as Czech (Recasens, 1986, 1990). Fig. 3.7c illustrates the difference in contact pattern between [ɲ] as articulated in French, Catalan, and Ibibio. In observing the differences between Ibibio and the Romance languages, it is interesting to note that the palatal nasal that exists in the present-day Romance languages has evolved from an [nj] sequence in Latin (cf. James 1968 for French, Meyer-Lübke 1890-1906 for Romance generally), and does not go back to a single earlier palatal nasal.

For Ibibio, it was observed that quite frequently complete closure was not achieved, and what did obtain was a nasal palatal approximant, though apparently with more contact than for the oral palatal approximant<sup>73</sup>. This seems to be the case in much of Lower Cross. In most of the group, [j] is perhaps as frequently found as [ɲ]; in Iko, Itumbuso, and Usakade, the nasal approximant is the more common realization. There is, on the other hand, little evidence for even occasional manifestations of a sequential [nj] realization. In Ibuoro this may occur; based on the data available to me, it is not possible to determine whether instances of [nj] there, which correspond to [ɲ] elsewhere, are variable realizations of [ɲ], or whether a merger has occurred in Ibuoro with certain words with [nj]. Kaufman (1985) lists a number of words in Ibibio as having alternative pronunciations, e.g. 'have' [níé ~ jíé], 'who?' [àníé ~ àjíé], though it is not clear whether she intended this to mean these are variable pronunciations across speakers, or alternatives available within speakers (cf. 'she/he/it' [àjíé], which does not permit this variation). My own research does not support the hypothesis that both alternatives are available to the same speaker. In Anaang (at least for Abak and Ukanafun dialects), words cognate with those words in Ibibio having variable pronunciation seem only to have [ɲ].

Kuperus (1978), in describing the phonemic inventory of Oro, makes no reference to a palatal nasal at all, analysing all potential occurrences of [ɲ] as [nj]. My own impressions of Oro, however, don't agree with those of Kuperus; there is indeed a

<sup>73</sup> I refer to this as an approximant, but it is certainly an articulation involving 'close approximation' of the articulators, with any turbulent noise generated in the oral cavity being masked by the nasal resonance.



palatal nasal which undergoes some variation with regard to degree of contact, e.g. [ɲí] ‘gather’, [ɲáɲáɲá] roofing grass, and [jè] ‘buy’ (cf. ɲàm, ɲè elsewhere) and as elsewhere in LC, it is in opposition with [nj], as can be seen in the following examples: [ɔ̃ɲɔ̃] ‘sky’ vs [ɔ̃njɔ̃] ‘far’.

### 3.7.6. Velars

[k], [g]: A voiceless unaspirated stop [k] is found throughout the group. Like [t] and [s], in initial position it is relatively forcefully articulated and relatively stable. This is particularly true in back vowel and low vowel environments, as seen in words such as kók ‘grind’, or íkáj ‘fire’, which are virtually identical in pronunciation across the group<sup>74</sup>. As was seen for Ibibio, however, [k] can undergo substantial variation in place of articulation according to vowel context. It appears that everywhere in Lower Cross [k] becomes at least pre-velar, if not always a true palatal, when followed by [i] or [e]. This is clearly more pronounced in ItuMbuso, where such instances of /k/ are completely palatal [c], and occasionally are affricated, [tʃ], as in ‘egg’ [ɲcién], or ‘insult’, [tʃiɔ̃wòm]. It is interesting to note that for ‘egg’, the nasal prefix retains its velar place of articulation, indicating a movement forward of the contact during the articulation of the sequence; in other words, the influence of the vowel does not extend back as far as the nasal. A similar phenomenon with [nt\_] sequences in Ibibio was revealed with the EPG work (see §§3.2, 3.5, above).

Variation in realization of /k/ is to be seen more in ambisyllabic and (to lesser extent) final position, and is returned to below. There is also certain variation in evidence as to the voicing characteristics of the velar stop; these as well are discussed below. Here I will simply mention that in Obolo there is a voiced velar stop /g/, and also in Iko, though in Iko its phonemic status is not clear.

### 3.7.7. Labialized velars

[kʷ], [gʷ]: Labialized velars occur throughout the group, though not in all cases with phonemic status. As might be expected, velar stops are labialized when preceding a rounded vowel; in these instances, there is no perceptible off-glide from the consonant to the following vowel, e.g. Ibibio ‘there’, [kò]. On the other hand, there are labialized velars where there is a perceptible off-glide, and where it is, for some researchers, more appropriate to analyze these as being single phonemes, rather than sequences of two phonemes. Faraclas (1984a) prefers this analysis for Obolo, as in

<sup>74</sup> Certain variation does exist in these words, such as the final [k] in kók becoming a glottal stop in Ekit, and variation in the initial vowel prefix in ‘fire’. The initial [k], however remains unchanged.

'sing' /k<sup>w</sup>ák/, where similar forms in other LC languages have been regarded as sequences; e.g., Cook for Efik, (e.g., 'sing' /kwɔ́/), or Kuperus for Oro<sup>75</sup>. In Ibino, however, it is appropriate to see [k<sup>w</sup>] as being phonemic, as in 'kill' [k<sup>w</sup>òt], compared to 'leg' [úḱót] or 'see' [ḱút]. In most Lower Cross languages, the /kw/ sequence is alternatively realized as [ku], [kw], or [kw̥]; this is rarely, if ever, the case with Ibino /k<sup>w</sup>/, and we note that /k<sup>w</sup>/ in Ibino has its origins in PLC \*g<sup>w</sup>.

[g<sup>w</sup>]: The voiced labialized velar stop is similar in articulation to its voiceless counterpart described above, in that it is perceived as a velar stop with a labial off-glide (i.e., [g<sup>w</sup>], as opposed to [g]). It occurs regularly in initial position in Anaang (particularly the Abak and Ukanafun dialects), Efai, Iko, and Obolo, and with less frequency in Ebughu, Enwang, Ibuoro, Ilue and Uda. In this latter set of languages, the velar closure shows signs of being 'eroded', such that a labial-velar approximant replaces it, or what might be called a 'pre-velarized labial-velar approximant'. That is, the approximant is frequently preceded by a very brief dorso-velar closure, which may be transcribed as [ḡw], as in Enwang 'paddle!' [ḡwè]. In the other languages of the group, the labial-velar approximant [w] is the usual realization, having replaced PLC \*g<sup>w</sup>. In other words, the frequency of occurrence of [g<sup>w</sup>] across the group is variable, and where it does occur, the degree of velar constriction is also variable.

### 3.7.8. Labial-velars

[kp]: The symbol [kp] is used here as a cover for a variety of phonetic manifestations of what is nominally a voiceless labial-velar stop, which occurs in almost all Lower Cross languages. Only Ebughu, Enwang, and Okobo seem never<sup>76</sup> to have [kp]; in each of these it has been replaced by [p]. The Ikot Ekpene dialect of Anaang is considered locally to have [p] rather than [kp], and generally this is true, though I have met speakers of this dialect who have [kp] in their speech; it is quite conceivable that these speakers have come under influence from Efik and Ibibio. Other than these four languages, we also find that in Uda [kp] has in large measure given way to [p], though not entirely, and a similar situation seems to exist in ItuMbuso<sup>77</sup>. Finally, we find [kp] has also partially given way in Usakade, though in this case to [b]. The

<sup>75</sup> It has been suggested (e.g., Anderson 1976) that Ward postulated /k<sup>w</sup>/ for Efik. There is no evidence for this in Ward's writing; moreover, it should be recalled that Ward was not writing in a tradition that required resolution of this sort of issue.

<sup>76</sup> For each of these three the few words which might turn up a [kp] can safely be seen as borrowings, likely from Efik. My Ebughu informant suggested there were dialects which also had [kp], but it was not clear whether he was referring to Ebughu, or some of the neighbouring languages, such as Oro.

<sup>77</sup> My informant for ItuMbuso vacillated between using [kp] and [p] in certain words, while in others he was consistent in his usage. As he had lived in Calabar (an Efik-speaking town) for nine years, it is possible that his use of [kp] was due to this influence.

circumstances for Usakade are different than for other languages in the group; these issues are discussed in the following chapters, but again it seems probable that even for Usakade words containing [kp] are borrowed, from within Lower Cross. [kp] is present in all of the other languages of the group.

The various instrumental analyses done on Ibibio [kp] as presented in §3.6 showed it to be considerably variable in production both within and across speakers, and there was some evidence that the across speaker variation might to a certain extent be related to dialect. This suggests that variation in the labial-velar found cross-linguistically in LC needs to be regarded with care, as differences could be due either to the particular speaker used, or they could be characteristic of the language or dialect in question. And for no language (other than Ibibio), have enough speakers been examined to allow for a confident statement concerning the correlate of the differences observed.

For Efik, Ward (1933: 7-8) describes the two gestures (labial and velar) as being simultaneous. She further suggests that the vocal cords may be closed and, as mentioned in §3.6, describes it as sounding like 'kb', but denies there is any voice in the stop. For her, then, the stop is voiceless unaspirated, and the kymograph traces she presents support this conclusion, showing no evidence of prevoicing, or of an ingressive airstream mechanism, whether velaric or glottalic. Cook's description (1969a: 23ff) concurs with that of Ward, in claiming that it is produced on an egressive airstream and that the two closures "begin at exactly the same time" (p.24). These descriptions are at odds with my own impression of Efik [kp] as produced by any Efik speaker I have heard. My own observations suggest that in its production, Efik [kp] is essentially similar to that of Ibibio<sup>78</sup>, particularly with regard to its variability. This variability could account for the discrepancy between my observations and those of Cook and Ward, especially regarding the lack of ingression and voicing seen in Ward's kymograph tracings. However, as the spectrograms of Efik [kp] in Fig. 3.7d show, like that of Ibibio, it is clearly prevoiced, with the first token showing a voicebar of 16 ms against a total duration of 128 ms, and the second a voicebar of 27 ms against a total duration of 115 ms. And, although less clear on the spectrogram presented here due to its weaker nature, VTTs of 27 ms and 25 ms were found for the two tokens, òkpó and ékpè, respectively. (A second instance in the text of the same word revealed values of TD = 142 and 108 ms; VTT = 42 and 48 ms; VOT = 22 and 25 ms for the two labial-

<sup>78</sup> Native speakers of Efik and Ibibio concur; on the other hand Ibibio speakers and Yoruba speakers can be quite aware of a difference between the labial-velar stops of these two languages.

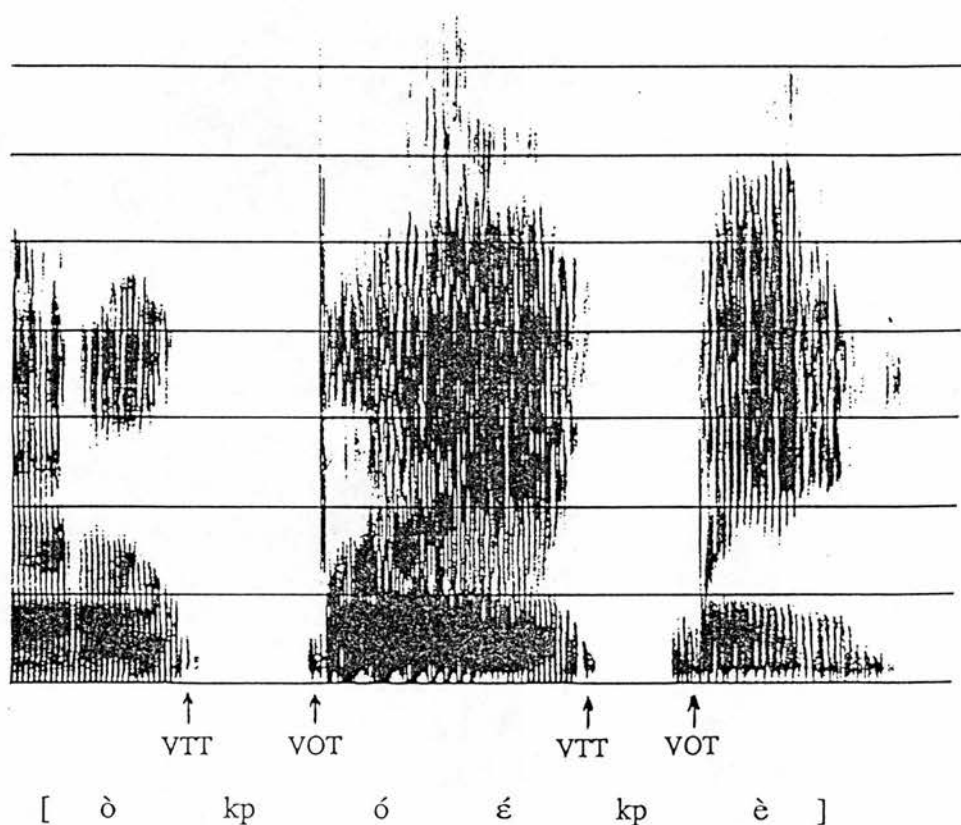


Fig: 3.7d: Spectrogram of the Efik utterance òkpó-ékpè [òkpóékpè], 'male leopard', illustrating characteristics of Efik [kp]. VTTs and VOTs are indicated by arrows. TD for [kp] (òkpó) is 128 ms, with VTT = 27 ms and VOT = 16 ms; for [kp] (ékpè), TD = 115 ms, VTT = 25 ms, and VOT = 27 ms. Frequency scale is in kHz steps. (Taken from a text of running speech; speaker: Grace Arit Ibanga Inyang-Brassem, tape provided by T.L. Cook.)

velars, respectively.) These values are in line with those found for Ibibio [kp]. If there is a consistent difference between Efik [kp] and that of Ibibio, it may be that Efik, at least auditorily, seems to involve less of a velaric airstream (i.e., less rarification of oral pressure), as the 'pop' mentioned earlier as sometimes being associated with Ibibio [kp] is less frequently heard in Efik. Auditorily, however, it is clear that for Efik [kp], the velar closure does frequently precede the labial one, that there is suction of the type associated with the velaric airstream mechanism in Ibibio, and that there is a certain amount of prevoicing. These auditory impressions are supported by the spectrographic evidence presented in Fig. 3.7d, where F2 transitions appear to suggest labiality for the closure of the first [kp], but velarity for the second.

For Oro, Kuperus simply describes the labial-velar as being voiceless and as having simultaneous labial and velar articulations. It is, however, auditorily quite similar to that of Ibibio; the impression of suction or implosion is quite strong, and the prevoicing is normally quite noticeable. In fact, [kp] in Oro seems to be subject to greater closure voicing, i.e., both prevoicing, and an apparently longer VTT than other LC languages; this is returned to shortly. It differs from that of Ibibio in that the impression of accompanying labialization is more frequent, e.g., 'leopard', [ʒkpʷi]. This effect is strongest with following high vowels. A spectrogram of Oro /kp/ is given in Fig. 3.7e, for the utterance [íkɔ̀nɛ] 'cocoyam', where formant transitions, as for Ibibio, suggest an earlier velar closure and a later labial release. This particular utterance also gave a strong auditory impression of voicing during the closure, which was reflected in the voicing measurements; VTT was revealed to be 45 ms and VOT 53 ms, the two together comprising almost the total duration of the stop.

Similar statements could be offered for [kp] as it occurs elsewhere in the group; in all LC languages the impression of suction or implosion is normally present, as is the voiced release. It is therefore reasonable to conclude that basically the same production mechanisms are used; in particular a velaric ingressive airstream mechanism, and in all likelihood a glottalic ingressive one as well. This does not seem to be characteristic of /gb/ in Obolo, however, few tokens only exist of this in my data. Fig. 3.7f gives spectrograms of Obolo /kp/ and /gb/, which again demonstrate variability regarding the timing of the labial and velar articulatory gestures. For [íkɔ̀pí], 'rat', the F2 VC transition is negative, suggestive of labiality, while for [égbè], 'leopard', a positive, velar transition for F2 is apparent. However, for the CV transition, both indicate a later labial release. The different voicing characteristics for voiced and voiceless labial-velars are also apparent from the spectrograms; [gb] shows voicing throughout,



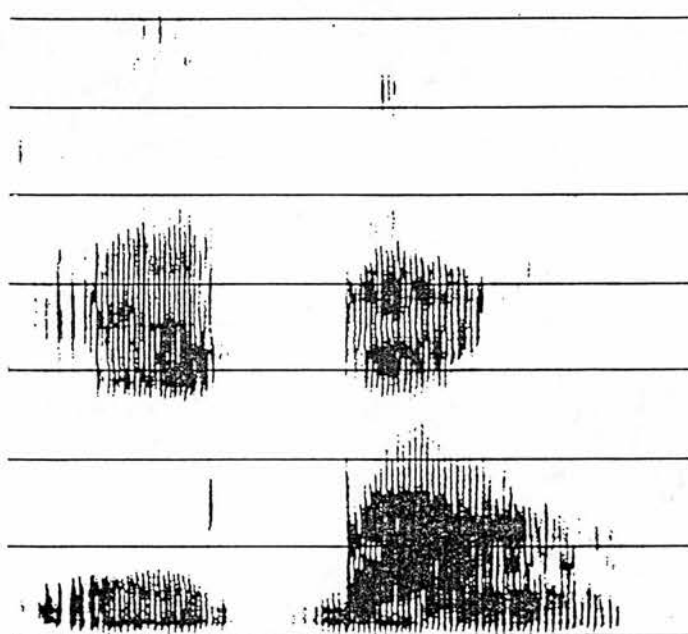
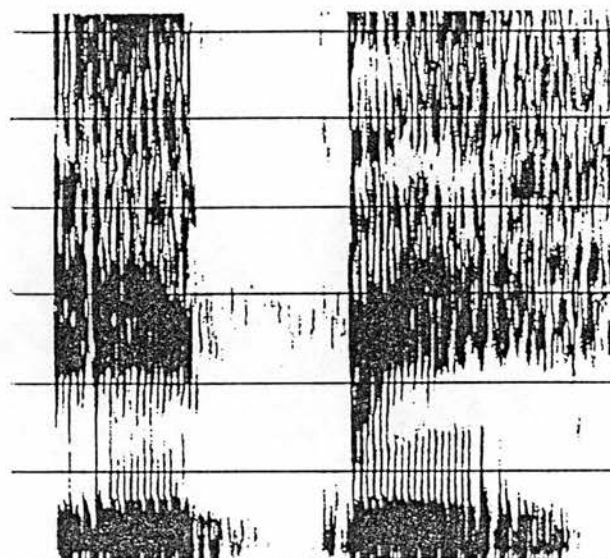
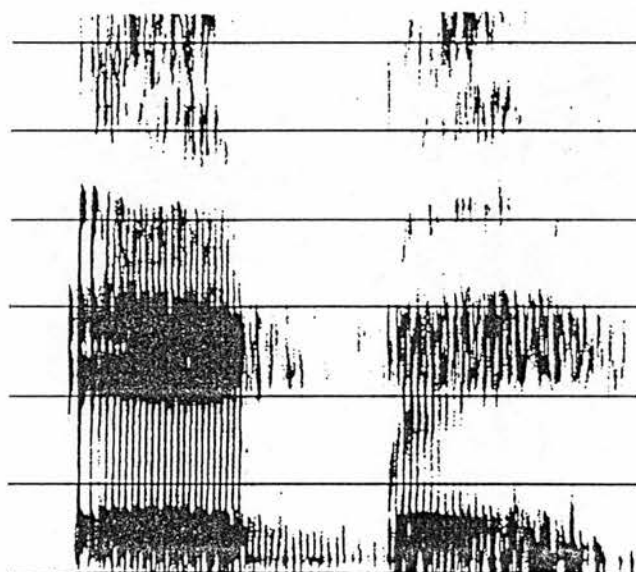


Fig. 3.7e: Spectrogram of Oro [kp], showing asymmetrical formant transitions indicative of asynchrony in the timing of the two articulatory gestures. Total duration of closure is 111 ms; a VTT of 45 ms and VOT of 53 ms were measured. Frequency scale is in 1kHz steps. (Speaker: Uduak Edet Bassey.)



[kpí]



[égbè]

Fig. 3.7f: Voiceless and voiced labial-velar stops in Obolo (Ikuru dialect). Both suggest an asynchrony between the two articulatory gestures; [kp] of /íkpi/ 'rat' has a TD of 130 ms, a VTT of 64 ms and a VOT of 23 ms; [gb] of /égbè/ 'leopard' is fully voiced, with a TD of 125 ms. (Speaker: B. Belejít.)

although it seems to weaken just before release, while the voicing characteristics of [kp] are similar to those observed elsewhere in Lower Cross, having a gradually decreasing voicing tail (VTT = 64 ms) and a strong onset to voicing (VOT = 23 ms). (For [kp] in both Oro and Obolo in the spectrograms in Figs 3.7e and f, the voicing tail may in fact have been longer than what the spectrograph allowed to be detected - cf. §3.4.4.1).

[w]: The voiced labial-velar approximant occurs in initial position primarily in Efik, Ekit, Etebi, Ibibio, ItuMbuso, Okobo, Ukwa, and Usakade - i.e., other than those languages where [g<sup>w</sup>] ~ [ɣw] is more commonly found. Still, as the palatography done for Ibibio [w] revealed, it is not unusual for the approximant to involve a very brief dorso-velar closure. This suggests that the approximant should perhaps be classified as a labialized velar, indicating the velar closure to be the primary articulation, as Cook (1969b, personal communication) has done for Efik. However, the EPG evidence for Ibibio (presented in Chapter 5) indicated that this dorso-velar closure is not always present, and that the constriction can in fact be quite open. Consequently, I have opted for a label that recognizes that both constrictions are of equal importance, even though they may not always involve equal degrees of closure.

Finally, in both Anaang and Ibibio (dialectally), [w] occurs corresponding to [b] elsewhere in the group. Based on auditory evidence, it seems the brief dorso-velar constriction described above does not occur in these cases, though further investigation of this is desirable. It bears mentioning in this regard that Anaang has contrastive /w/ ~ /g<sup>w</sup>/, and for both Anaang and Ibibio a merger of PLC \*b and \*g<sup>w</sup> is at least partially occurring, and it would be of interest to determine whether there is any difference between the [w] reflexes of the two in terms of degree of velar constriction.

### 3.7.9. Voicing Characteristics

The instrumental work for voicing done on Ibibio indicated that a certain amount of variability exists with regard to voice onset time for voiceless consonants (though in Ibibio these are all best regarded as being unaspirated), but more interestingly with regard to voice termination time (see Tables 3.4b and 3.4c). For this latter characteristic, it will be recalled that on occasion for both [k] and [kp], voicing was seen to carry on throughout the closure, almost to the instant of release in the case of [k], or to the resumption of modal voicing in the case of [kp]. However, it will also be remembered that this closure voicing, judging by the Lx record, was not of the same nature as normal modal voicing, but rather, that it was apparently weaker, and involved an incomplete closure of the vocal folds. A physiological/aerodynamic account of this was offered in §3.4.4, suggesting this was due largely to passive factors, rather than

under active muscular control.

A similar situation obtains in other Lower Cross languages. As was noted above [p], in those languages which have it in initial position, is at least on occasion noticeably aspirated (e.g., in Ibino, Ebughu, and Enwang), though normally it is not. On the other hand, [k] remains unaspirated throughout. Regarding VTT, the relatively long durations found for Ibibio also appear to exist in other languages of the group; the spectrograms of utterances from Oro and Obolo, in Figs. 3.7e and 3.7f respectively, provide instrumental support for this assertion.

Apart from these characteristics, which appear to be common to all LC languages, interesting developments regarding voicing appear to be taking place in Oro, Ebughu, and in Obolo, though somewhat differently in the latter. In Oro, [kp] seems to be subject to greater voicing during closure than that which obtains in other Lower Cross languages; this appears to be at least partially conditioned by word structure, as it is more likely to occur if [kp] is the first consonant in a compound formation or polysyllabic word - e.g., 'truth' [àgbáníkúð], 'table' [ògbókóró], and 'sea' [ògbónákpà], but 'first' [àkpá]<sup>79</sup>. In Ebughu and Oro, we find a change in voicing of certain consonants; what are realized as [k], [s], and [f] elsewhere in the group, in these two languages are often, but not always, voiced in cognate words, i.e., [g], [z], and [v]. For example, 'ground' [ízðŋ] but generally [ísðŋ] elsewhere in Lower Cross; 'heart/inside' - Ebughu [ázùt ~ ásùt], Oro [ógùt ~ ókùt]; Ebughu 'plantain' [ágàm] ([úkóm ~ ákám] elsewhere); 'cloth' [ðvðŋ] but [ðfðŋ] elsewhere; and 'slave', Ebughu [ðvðŋ], Oro [ívðŋ], but Efik [ófɪn]. Kuperus (1978) touches on the issue for Oro, admitting that a conditioning environment is elusive. Her suggestion that possibly neighbouring voiced consonants and/or close vowels effect the change is contradicted on at least two counts: a) it is possible to find instances of the voiced variants in environments other than those suggested, as shown by some of the examples just presented, and b) occurrences of the voiceless variants can be found in the specified environments. Moreover, Kuperus does not specify whether she considers the postulated conditioning environment to be preceding or following the affected consonant; since it would seem to be the preceding environment (due to distributional constraints, as outlined in Chapter Two), it is worth pointing out that high vowels ([i] or [u]) and syllabic nasals are by far the most frequently occurring sounds in this position in both Oro and Ebughu; therefore, if a change were occurring 'sporadically' it

<sup>79</sup> Both 'truth' and 'sea' are readily analysable as compounds; e.g., the first element of 'truth' is àkpá, 'first' or 'fundamental', and the second is íkúð, 'word'.

might, on cursory glance, appear to be conditioned by these sounds. I will only suggest here that in both Oro and Ebughu this seems to be a 'sound change in progress'; the change is affecting the same sounds in both languages (barring [kp], which doesn't occur in Ebughu), but it appears generally to be more advanced in Ebughu, and to have affected [s] and [f] more in that language, and [k] more in Oro. The issue is returned to in Chapter Five.

In Obolo, also, occurrences of voiced consonants are found where there are voiceless ones in cognate words in the other languages. For the most part, these are instances of Obolo [gb] paralleling [kp], and [g] paralleling [k] elsewhere, but a [d] - [t] correspondence is also in evidence. Examples are: 'leopard' [égbè], [ékpè], etc. elsewhere; 'jaw' [ùgá], but [ùká] in Ibino and Efai; 'pot', [úgò], but [òkò] or [àkò] elsewhere (e.g., Efik, Usakade, Anaang, and Ibibio); 'beans', [ṛṛgódí], but [ṛṛkódí], etc., elsewhere; 'okra' [édéké] vs [átíké], etc., elsewhere. Unlike the Ebughu/Oro data, there are no instances in the Obolo data of change in voicing for fricatives, and the [gb] - [kp] correspondence apparently occurs in very few words, as most instances of Obolo [gb] seem to be in words that do not have cognates in other Lower Cross languages. Finally, there are a few instances of [g] and [gb] in Iko, which have voiceless counterparts elsewhere in Lower Cross, but again there is no evidence of this for the fricatives<sup>80</sup>, nor for alveolar stops. It is possible that since Obolo is the closest prestige language to Iko, (in fact Iko is frequently taken to be a dialect of Obolo), the existence of [g] and [gb] in Iko is a result of contact with Obolo.

### 3.7.10. Consonants in Final Position

Throughout the group, the consonants which can appear finally (i.e., in pre-pausal position) are restricted in both distribution and realization (as outlined in Chap. Two). Generally speaking, only [p t k m n ŋ] are found; that is, all oral consonants in this position are voiceless and unreleased<sup>81</sup>. There are, however, a few instances where, auditorily, final stops do appear to be voiced. For the most part this phenomenon is inconsistent across repetitions of the same word, and can be attributed to variation in voice termination time; in tokens where this has been checked spectrographically, the range for VTTs seems similar to what obtains for initial voiceless stops. In certain words, though, there is consistency, not only within

<sup>80</sup> Note that Iko [z] does not correspond to [s] elsewhere.

<sup>81</sup> Native speakers of the Lower Cross languages often suggest that there are 'voiced' consonants finally, i.e., b, d, in terms of orthography, but phonetically these are clearly voiceless, and it appears that these speakers associate the symbols b, d vs p, t with the unreleased as opposed to released aspect of these stops.



speakers, but also across languages. One clear example of this is [óbód-] ‘mountain / hill / slope’, which has this realization in Anaang, Ekit, Oro, Uda, and Ukwa, but the final stop is devoiced elsewhere in the group.

Also of interest is variation in place of articulation noticeable for final velar stops *vis á vis* their initial counterparts. Kuperus (1978) has remarked on this for Oro, observing that in final position /k/ is sufficiently retracted to call it a uvular stop [q]. The same can be said for perhaps all LC languages. Certainly in Efik and Ibibio it is true, at least when preceded by a mid or low back vowel, that /k/ is noticeably retracted relative to pre-vocalic /k/, and in all the languages of the south-eastern littoral, final [q] is common regardless of the preceding vowel context. This variation is of interest in considering the articulation of ambisyllabic consonants discussed in the following paragraphs.

There is also in Lower Cross, as mentioned in Chapter Two, a tendency for final consonant attrition. This can be considered an areal feature, as it appears restricted to a particular sub-region within the Lower Cross speaking area. The languages most affected are those of the south-east coastal region: Oro, Ebughu, Enwang, Uda, and Efai. It also extends inland, though to a lesser degree, in Etebi and Ekit, and across the estuary of the Cross River, in Usakade.

### 3.7.11. Consonants in Ambisyllabic Position

In Chapter Two, some attention was paid to the distribution and realization of consonants in ambisyllabic position. It was stated there that throughout the group the set of consonants which may occur in this position is restricted to realizations of /b t k m n ŋ/, and that these realizations are usually tapped stops, fricatives, or approximants - [ḃ β ɾ ɽ ɣ ʎ ɰ ɰ̥ ɹ ʁ]; only [m] seems to remain largely unreduced. On rare occasions (i.e., in certain words) one finds the velar realization to be voiceless, as in Ibibio [átíkÉ] ‘okra’, or Uda ‘stone’, [útíkÉ]; however, even with these, the contact duration is sufficiently short as to refer to it as a tap. What is perhaps more common, though, is a zero realization of an underlying velar; this is particularly true for conversational speech (at least for Efik, Ibibio, and Oro, but likely throughout the group), though it can also occur in citation forms.

In Ibibio, the EPG investigation revealed greater reduction of alveolar contact for ambisyllabic consonants occurring word internally than for those occurring across word boundaries (e.g., /àkpàrà/ [àkpàrà], ‘prostitute’ vs /bàd àkò/ [bàràkò] ~

[bàdàkò], 'count (the) pots'), despite little or no perceptual difference. A similar phenomenon appears to occur in the other languages of the group, at least to the extent that it has been possible to examine this. Certainly similar variation can be observed for Efik, both spectrographically and auditorily (cf. Fig. 3.4b, where the final /d/ of /ítiád/, which is ambisyllabic in this utterance, is realized as [d] rather than [r]).

### 3.7.12. Summary

The aim of this section has been to bring out the major phonetic characteristics which serve to differentiate the various Lower Cross languages. As has been noted *passim*, there are also a number of characteristics which are more or less common to the group. To conclude the section, and the chapter, these are summarized here.

The roots of the common aspects may perhaps be found in phonological characteristics which seem to belong to the group as a whole - in particular the uneven distribution and realization of consonants - and therefore can be traced back at least to Proto Lower Cross. These were discussed from a phonological perspective earlier, in Chapter Two. Consonants in initial position generally have a strong realization; those in final or ambisyllabic positions have a weaker, or reduced, articulation. The strong articulations are reflected in features of articulation such as greater linguo-palatal contact and an affricated release, as was seen for voiceless alveolars throughout the group, or the possibility of a stronger articulation - e.g., the affrication of the palatal fricative/approximant. Given these characteristics, it may seem paradoxical to also claim that the possibility for the reduction of these consonants is also a characteristic of the group. Nonetheless, this is in fact the case, for throughout the group these initial consonants are undergoing erosion, or reduction. Of the oral stops, only [k] is not apparently subject to reduction (unlike in the related languages of the Ogoni and Central Delta groups). Where the interesting variation lies across the group is in the degree of reduction that obtains in the different languages. This was most clearly exemplified by perhaps the variation found between [d ~ r ~ ɾ], but was also seen with palatal and (labialized) velar nasals, and also the variation between labial-velar approximants and voiced labialized velar stops.

Similarly with ambisyllabic consonants, tapped realizations are a commonplace across the group, but the degree of erosion of these across the group is variable. In some instances, it was seen that a velar contact could be voiceless, but other than these few cases, ambisyllabic consonants are voiced. In conversational speech, velars tend to be elided completely.

The following chapter turns to a reconstruction of the consonant system of Proto Lower Cross; this, to a certain extent, is based on traditional reconstruction techniques - i.e, the comparative method. An attempt is made, however, to provide a 'phonetically-informed' reconstruction (cf. Elugbe 1989), and to this end, the material presented in this chapter is drawn on in the next.

## Chapter Four

### The Historical Development of Lower Cross Consonants

#### 4.1. Introduction

This aim of this chapter is to present a reconstruction of the consonant system of Proto-Lower Cross. It fits in to the overall plan of the dissertation in that, if we are to discuss sound change, the directionality of change (as opposed to simply stating a correspondence), must be established. It would not be sufficient simply to say that 'PLC \*X became Y'; since there has never been a reconstruction of Proto-Lower Cross, the postulated consonant system must be validated. In addition, in view of the lack of historical work done on Lower Cross and its near relatives, the chapter can also be considered an independent work in its own right, as a contribution to historical African linguistics<sup>82</sup>.

The approach to historical reconstruction adopted here differs to an extent from that of linguists such as, say, Meillet (1966), Lehmann (1962) or Peeters (1988) who argue that in doing reconstruction we are only able to arrive at formulae which express relationships among elements of sets of correspondences, and that the results of attempts at phonetic reconstruction are always hypothetical. Rather, the approach of Lass (e.g., Lass and Higgs 1984) seems less defeatist, and more concerned with the

---

<sup>82</sup> This chapter is a substantially revised version of a paper presented at the 17th Colloquium on African Languages and Linguistics, Leiden, Sept. 1987 (= Connell 1987b).

actual mechanisms of sound change<sup>83</sup>. In many circumstances it is possible to reconstruct with a fair degree of confidence the phonetic nature of a proto-language, given sufficient information concerning the phonetics of the daughter languages; that is, accepting that sound change results from a particular set of phonetic conditions, those conditions must be reconstructible based on information from the reflexes.

In other words, while my methodology for reconstruction is based in the principles of the Comparative Method, these principles are supplemented by phonetic information. Sound change is *sound* change, and therefore the *phonetic plausibility* of a particular development (or reconstruction; cf. Lass 1978, and his discussion of 'mapping' and 'projection') must be taken into account. In addition, whenever possible, cognate words from other Delta Cross languages and beyond (see the Introduction for the Lower Cross family tree) have been examined, to aid in the reconstruction of individual lexical items. That is, reconstruction is assumed to be a 'forward' as well as a 'backward' looking process.

As elsewhere in this work, unless indicated, the transcriptions used are not intended to be orthographic or phonemic; rather, they should be considered to be broad phonetic (i.e., allophonic, containing the detail necessary to substantiate a given argument), as it is this information which is important in understanding sound change. The core of the database used for the reconstruction was, as explained in the Introduction, a Swadesh-type wordlist, but expanded to 565 words. This list, for all LC languages under consideration is found in Appendix A.

#### 4.2. The consonant system of Proto-Lower Cross

In many, but not all, cases the reconstruction proved to be relatively straightforward, as there were sufficient instances where cognate forms were available in all of the languages. Difficulties sometimes arose as a result of a lack of cognates, or in some instances a multiplicity of reflexes. Rather than present the consonant systems of each Lower Cross language (or rather, their phonemic inventories; for this,

---

83 The example presented by Lass and Higgs (1984) concerns the phonetic nature of Old English /r/. They argue that this phoneme must have been realized as [ɹ̥+] (a pharyngealized, advanced velar approximant, like that found in much of present-day North American English), as this would have provided the conditioning environment implied by certain developments in the vocalic system of English.



	Labial	Labio-dental	Alveo-lar	Palatal Av'lar	Palatal	Velar	Labiz'd Velar	Labial- velar	Uvular	Glottal
nasal	m	ɱ	n		ɲ	ŋ	ŋ <sup>w</sup>	ɲm		
stop	p b		t d		ɟ	k g	k <sup>w</sup> g <sup>w</sup>	kp gb		ʔ
fric		f v	s z		jɿ	ɣ				
affric				tʃ dʒ	dʒ					
lat'l			l							
tapped	b		r			g			ʀ	
approx	β		ɹ		j	ɰ		w		

Table 4.2a: Major phonetic sound segments of the Lower Cross languages.

	Labial	Labio-dental	Alveo-lar	Palatal Av'lar	Palatal	Velar	Labiz'd Velar	Labial- velar	Uvular	Glottal
nasal	m		n		ɲ	ŋ				
stop	b		t d		ɟ	k	g <sup>w</sup>	kp		
fric		f	s							
affric										
lat'l			l							
tapped										
approx										

Table 4.2b: Reconstructed consonant phonemes of Proto-Lower Cross which occurred in initial position.

see Chap. Two), Table 4.2a shows the major consonants that exist phonetically in Lower Cross. For the most part, each is phonemic in at least one Lower Cross language. Table 4.2b. presents the reconstructed proto-system. One of the more interesting aspects in doing the reconstruction was the possible existence of a fortis/lenis distinction in PLC; this issue is treated immediately below. Other questions of interest include the number of nasal consonants that existed (phonemically) in PLC, whether palatal stops are reconstructable, and the number of initial consonants having a velar place of articulation. These questions are all treated in turn, during the illustration of individual reconstructions.

In presenting the reconstructed system, focus is placed on consonant occurrences in stem initial position, for even though some Lower Cross languages currently have consonant oppositions which do not occur stem initially (see Chap. Two), these are not reconstructible for PLC. A few remarks on final and ambisyllabic consonants in PLC are given in the concluding paragraphs of this chapter.

#### 4.2.1. A fortis/lenis opposition in Lower Cross?

Both Dimmendaal (1978) and Sterk (1979, n.d.) have reconstructed a fortis/lenis opposition for Proto Upper Cross, and Elugbe and Williamson (1984) have suggested one for pre-Abua (Abua is in the Central Delta group). One of the problematic aspects of these reconstructions is determining what the phonetic nature of this opposition would have been. Elugbe and Williamson provide evidence that for Abua, the distinction was in all likelihood primarily one of length. Sterk (1979: 61) argues that synchronically in the Upper Cross languages, the fortis/lenis distinction is manifested either as one of length, or one of 'strength of articulation' (this undefined, phonetically); and in some languages, that the earlier opposition has been neutralized. Dimmendaal (1978: 47ff.), on the other hand, suggests that VOT (i.e., fortis consonants being aspirated) may have been the primary phonetic correlate of the opposition in PUC. The interest here is that an opposition that is realized synchronically as length in some languages, and strength of articulation in other, related languages, has apparently evolved from the same 'parent' opposition; the phonetic nature of this earlier opposition, then, should presumably be discoverable, at least in broad terms, as only a limited set of phonetic attributes could give rise to the variety of present-day reflexes. However, there are numerous discrepancies between Dimmendaal's and Sterk's reconstructions for the PUC consonant system (i.e., apart from their differing interpretations as to the present-day phonetics), and clearly another

look at this group is warranted. Assuming the differences are reconcilable though, and assuming a correlation can be established between evidence for the opposition in Upper Cross and Central Delta, this would indicate a fortis/lenis opposition in their most recent parent, i.e., Delta Cross.

Despite this possibility, though, there appears to be no straightforward correlation between the reconstructed consonant system of PUC (neither Dimmendaal's nor that of Sterk) and that arrived at for PLC (note that there is no fortis/lenis opposition synchronically in LC); moreover, postulating a fortis/lenis opposition for Proto-Lower Cross appears to be both unnecessary and unwarranted, with regard to understanding the sound changes that have occurred<sup>84</sup>. It is therefore argued that a fortis/lenis distinction, if it did exist elsewhere in Cross River, must have disappeared at a stage pre-Lower Cross.

#### 4.2.2. The nasal series

The nasal consonants \*m, \*n, \*ɲ, and \*ŋ have all been reconstructed as initially occurring consonants in PLC, as this series exists in cognate sets in each of the present-day languages. In certain respects, however, these reconstructions may be considered problematic. A question may be raised as to whether these were possibly nasal allophones of oral consonants, for, as the examples in Tables 4.2c-f<sup>85</sup> show, an initial nasal in Lower Cross generally implies a nasal stem finally as well (if a final C is present), suggesting that this final nasal may be a conditioning environment for the initial one (i.e., /CVN/ > [NVN]). However, there are also stem final nasals occurring where the accompanying initial consonant is oral (/CVN/ > [CVN]), as well as numerous examples of initial nasals without a final nasal consonant (/NV/), and with no indication of an earlier final nasal having been lost. The possibility of initial nasals being allophones of oral consonants is therefore discounted. However, in comparing forms from Lower Cross with their cognates in Upper Cross, some evidence is found that anticipatory (regressive) nasalization has played a role in the development of Lower

84 Despite having postulated a fortis/lenis contrast for Upper Cross, Dimmendaal, in his discussion of Efik, suggests the distinction was lost in "pre-Efik or earlier" (1978: 200). Faraclas, on the other hand has argued for the existence of such a contrast at the PLC stage (Faraclas, unpublished mss).

85 In the table, sources for words drawn from other Delta Cross languages (or language names) are given in parentheses: For PUC, S = Sterk, D = Dimmendaal; for Ogoni, reconstructions are from Williamson (n.d.), others are from individual languages; K = Kana, Gk = Gokana, El = Eleme. For Central Delta, Abua words are from Gardner (1980) or Wolff, (1969). Double asterisked forms are my own reconstructions.

Cross, as it would appear that it is this process which was responsible for the emergence of both [ɲ] and [ɲʷ] in PLC. This was presumably pre-Lower Cross; a more conclusive statement must therefore await a reconstruction of Delta Cross, but cf. Dimmendaal's discussion, 1978: 203 - 204.

There are very few words to be found in any LC language that exhibit a /NVC/ structure, and interestingly all of those have /k/ finally (e.g., *nèk*, 'dance', which exists in most Lower Cross languages). This fact may have important implications for the evolution of final consonants, suggesting that there was also a period of lagging (progressive) nasalization, which had least effect on velars (but note there are many instances of /NVɲ/ but again it would appear that these developments were at a stage pre-Lower Cross.

Tables 4.2c and 4.2d give evidence for PLC \*m and \*n, respectively, having occurred in initial position. In both cases these reconstructions are supported not only by comparative evidence from within the group but, where possible, also by evidence of cognate words from related language groups. These same sets of cognates provide some evidence that \*/m/, \*/n/, and \*/ɲ/ also existed finally in PLC, e.g., \*úɲàm 'meat', \*éɲim 'elephant', \*mèn 'swallow, and \*mímóɲ; further evidence for this, and for these consonants occurring medially (ambisyllabically) can be found in the tables below (see also Appendix A).

Tables 4.2e and 4.2f present cognate sets which support the argument that \*/ɲ/ and \*/ɲʷ/ existed in PLC. Recalling that synchronically in all Lower Cross languages what is phonemically /ɲ/ is realized as [ɲʷ] initially; this is also assumed to be true of the parent language. The examples given also show the weakening, or erosion that PLC dorsally articulated nasals have undergone with regard to degree of linguo-palatal contact.

The evidence for the existence of [ɲ] in PLC might be used to argue that it could have been an allophone of \*/j/. This is particularly noticeable in regarding the paradigms for 'sell', 'eye', and 'sky', where there is a final nasal consonant in the reconstruction. This possibility, though, is contradicted by the evidence of 'shake'<sup>86</sup>,

---

<sup>86</sup> 'Shake' is perhaps better reconstructed as *jèk*, as the final vowel is likely a verbal extension. The ambisyllabic [ɲ] found in many of the languages is the result of a nasalization process found in several Lower Cross languages, which appears related to the inflectional morphology characteristic of the group.

	love / like	water	swallow	flog
Anaang	má	ní-múɔŋ	mèn	míá
Ebughu	mé	ní-mɔŋ	mǐèŋ	mwáí
Efai	mé	ní-mɔŋ	mǐèŋ	mɔŋí
Efik	má	ní-mɔŋ	mèn	míá
Ekit	mé?	ní-mɔŋ	měi	míá
Enwang	mé	ní-mɔŋ	mǐèŋ	máí
Etebi	mé	ní-mwɔŋ	mǐ	míá
Ibibio	má	ní-mɔ:ŋ	mèn	míá
Ibino	má	ní-múŋ	mèn	míá
Ibuoro	má	ní-múŋ	mèn	
Ilue		ní-mɔŋ	mèn	míá
Iko	mé	ní-mɔŋ	mèŋ	máí
ItuMbuso	má	ní-múŋ	mèn	
Obolo	mà	ní-múŋ	měŋ	
Okobo	mé	ní-múɔŋ	mè	mɔŋé
Oro	mé	ní-mɔŋ	mǐèŋ	kpáí
Uda	mé	ní-mɔŋ	mǐèŋ	máí
Ukwa	má	ní-mɔŋ	mèn	míá
Usakade	má	è-mɔŋ	mèn (-jà)	
PLC	*má	*'-mɔŋ	*mèn	*mínjá
PUC	--	*-nǐ (D)	*mè:dí (S)	--
Og	--	má: (K)	*měŋ	--
CD	--	àmò:m (Ab)	mìn (Ab)	--

Table 4.2c: Evidence for reconstructing PLC \*m



	mouth	animal / meat	elephant	give
Anaang	í-núà	ú-nàm	é-nĩ:n	nò
Ebughu	í-núê	ú-nâ	é-nĩ	nò
Efai	í-nwà	ú-nà	é-nèn	nò
Efik	í-núà	ú-nàm	é-nèn / é-nĩn	nò
Ekit	í-núà	ú-nà	é-nĩ	nò
Enwang	í-núà	ú-nà	é-nĩ	nò
Etebi	í-núà	ú-nà	é-nĩ	nò
Ibibio	í-nwâ	ú-nâm	é-nĩ:n	nò
Ibino	í-núà	ú-nàm	é-nĩ:n	nò
Ibuoro	í-núâ	ú-nàm	é-nĩ:n	nò
Iko	í-nwà	ú-nàm íkòt	é-nìn	nò
Ilue	í-núê	ú-nâ	é-nĩ	nò
ItuMbuso	í-núà	ú-nâm	é-nĩ:n	nò
Obolo	ó-tú	á-nàm	é-nĩ:n	ɲĩ
Okobo	í-núê	ú-nà	é-nĩ	nò
Oro	í-núê	ú-nà / n-	ɔ-nĩ	nò
Uda	í-nwà	ú-nâ	á-nĩ	nò
Ukwa	í-nwâ	ú-nâm	é-nĩn	nò
Usakade	í-ɲwâ	ɔ-réné úkò / i-	ó-nĩn / i-	nĩà
PLC	*í-núà	*ú-nàm	*é-nĩ:n / i-	*nò / *ɲĩ
PUC	--	--	*-nĩ (D)	*ní (D)
Og	nū (K)	*ñ-nām	*n-nĩ	nè (K)
CD	ò-nò	è-nàm / i-	--	nɔɣɔ

Table 4.2d: Evidence for reconstructing PLC \*n

	sell	eye	sky	shake
Anaang	ɲàm	á-ɲèn	è-ɲóŋ	ɲègé
Ebughu	ɲè	á-ɲè	ò-ɲóŋ	ɲìŋé
Efai	ɲè	é-ɲè	íkpe	ɲèk
Efik	ɲàm	é-ɲìn	è-ɲóŋ	ɲèŋé
Ekit	ɲè	á-ɲĩ	íkpa á-!ɲóŋ	ɲìgé
Enwang	ɲĩè	á-ɲĩ	ò-ɲóŋ	ɲàŋé
Etebi	ɲĩè	á-ɲĩ	íkpa á-!ɲóŋ	ɲèkɔ
Ibibio	ɲàm	á-ɲìn	à-ɲóŋ	ɲèwé
Ibino	ɲàm	é-ɲè	íkpa ó!ɲóŋ	ɲìŋé
Ibuoro	ɲàm	é-ɲìn	íkpa á!ɲúŋ	ɲèŋé
Iko	ɲàm	é-ɲè	è-ɲóŋ	ɲàŋ
Ilue	ɲè	ó-ɲĩ	è-ɲóŋ	ɲìŋĩ
ItuMbuso	ɲàm	é-ɲìn	íkpa á-!ɲúŋ	ɲèwé
Obolo	ɲám	é-tʃíèŋ / sèn	á-kpa é-ɲòŋ	sísík / tʃítʃík
Okobo	ɲè	á-ɲĩ	í-pa á-!ɲóŋ	ɲìné
Oro	ɲè	ŋ-kíníŋĩ	ò-ɲóŋ	ɲìŋé
Uda	ɲè	ú-síb é-ɲĩ	ò-ɲóŋ	ɲìŋé
Ukwa	ɲàm	á-ɲìn	íkpa á-!ɲóŋ	ɲàŋé
Usakade	ɲàm	é-ɲèn / a-	à-ɲóŋ	ɲòŋɔ (-sé)
PLC	*ɲàm	*é-ɲèn / a-	*íkpa é-!ɲóŋ	*ɲèk
PUC	*jàmá (S - 'buy')	*djènà (S)	--	(*míná (S))
Og	--	děě (Gk)	--	--
CD	--	ďièn	--	mim

Table 4.2e: Evidence for reconstructing PLC \*ɲ

	wife	drink	crocodile	know
Anaang	ḡ-ḡwân	ḡwónḡ	à-fiòm	rìòḡó
Ebughu	ḡ- ḡwâ	wónḡ	à-fèḡĩ	fiàk
Efai	ḡ-ḡwân	ḡwónḡ	à-fèḡĩ	ḡiòḡó
Efik	wân	wónḡ	ò-fiòm	ḡiòḡó / fiòk
Ekit	á-ḡwâ	ḡwónḡ	à-fiòm	ḡiòḡó
Enwang	ḡ-ḡwâ níó	ḡwónḡ	à-fèḡĩ	ḡiòḡó
Etebi	ḡwâ	wónḡ	à-fiòm	ḡiòḡó
Ibibio	á-ḡwân	ḡwónḡ	à-fiòm	ḡiòḡó
Ibino	ḡwâ	wónḡ	ò-fiòm	ḡiòḡó
Ibuoro	wân	wúnḡ	à-fiòm	ḡiòḡó
Iko	á-wâ	wónḡ	à-fiòm	ḡiòḡó
Ilue	ḡwâ níó	wónḡ	ò-fiḡĩ	fiák
ItuMbuso	wân	ḡwúnḡ	ò-fiòm	ḡiòḡó
Obolo	ḡwâ	ḡwónḡ	à-sàkwún	ĩwónḡ
Okobo	ḡwâ	wónḡ	à-fiòm	dèḡé
Oro	ḡwâ	ḡwónḡ	ò-fiḡĩ	fàk
Uda	ḡwâ	wónḡ	à-fèḡĩ	ḡiòḡó
Ukwa	ḡwân	wónḡ	è-fiòm	ḡiòḡó
Usakade	è-wân	ḡwónḡ (-sé)	è-fièm / a-	dèḡé (-sé)
PLC	*ḡwân	*ḡwónḡ	*ò-fiḡèm / a-	*ḡiòḡó
PUC	*-gg <sup>w</sup> à (S)	*gg <sup>w</sup> ât (D)	--	*djòḡá (D)
Og	*ò-wā	*wá	--	--
CD	àwání (Ku)	--	--	--

Table 4.2f: Evidence for reconstructing PLC \*ḡ

and also by other evidence, such as PLC \*jém ‘want’ or \*ójén (plural \*éjén) ‘child’, where the initial \*/j/ did not become nasal in environments similar to those of ‘sell’ and ‘eye’.

Only two items in the comparative data, ‘wife’ and ‘drink’, allow for a confident reconstruction of \*/ɲ/ in initial position, where it would have been realized as [ɲʷ]. Other examples are given that attest to its occurrence in final and ambisyllabic positions. In examining Table 4.2f, it is interesting to consider at the same time Table 4.2m, where it can be seen that the dorsal contact of the labialized dorso-velar \*[gʷ] has frequently eroded to the extent that [w] is the more common reflex of PLC \*gʷ. For the nasal, the same erosion is obviously under way, though at a slower pace, as is shown by the greater prevalence of [ɲʷ] over [w̃] (relative to [gʷ] and [w]). The nasal aspect here, then, seems to have a stabilizing influence similar in effect to that mentioned regarding variation in labial articulations in the previous chapter (this is also returned to below, in the following section). Strictly from an articulatory point of view, and comparing Tables 4.2f and 4.2m, it appears in this case that the lowered velum has helped in maintaining the dorso-velar contact.

Evidence from both Tables 4.2e and 4.2f indicates a process of anticipatory nasalization to have occurred in a period pre-Lower Cross. This is particularly apparent in comparing forms for PLC and PUC, cf. ‘sell’, ‘eye’, ‘wife’, and ‘drink’. An alternative analysis would be that denasalization had occurred in Upper Cross, but the additional evidence available from Ogoni and Central Delta (especially ‘eye’, but also ‘wife’ and ‘drink’) suggests that this alternative is the less likely of the two. Processes of nasalization and denasalization continue to exist in many of the present-day Lower Cross languages, and are discussed in Chap. 5.

#### 4.2.3. Labials

A voiceless labial stop [p] does not exist in initial position in most Lower Cross languages; in those which do have it, this stop can usually be traced back to PLC \*/kp/ (except in Ibino, where it is a reflex of PLC \*/b/). Consequently, \*/p/ has not been reconstructed for PLC. With regard to /b/, diachronic studies have shown this to be a somewhat unstable articulation<sup>87</sup>. The Lower Cross languages are no exception to this, for although \*/b/ is reconstructible for PLC, as the evidence in Table 4.2g attests,

<sup>87</sup> It is relatively easy to find examples of /b ~ v ~ w/ correspondences; developments in the Romance languages are one case in point.

	head	arm	breast	count
Anaang	í-wòd	ó-bók	é-bá	bàd
Ebughu	ú-búrò / m-	ú-βók	é-bé	bàt
Efai	í-búrò / m-	ú-bók	é-bé	bàt
Efik	í-búòt	ú-bók	é-bá	bàt
Ekit	í-búrò	ú-bá?	é-bé	bàd
Enwang	ú-búgù / mú-	ú-bók	é-bé	bàt
Etebi	í-bórò	ú-βá?	é-bé	bàt
Ibibio	í-wù:d / ŋ-	ú-bók	é-bá	bàt
Ibino	í-wò	ú-pók	é-pá	pàt
Ibuoro	í-búòt	ú-bók	é-bá	bàt
Iko	í-wò	ó-bók	é-bá	bàt
Ilue	ú-búrù	ú-bók	é-bié	bàt
ItuMbuso	í-bòt	ú-bók	é-bá	bàt
Obolo	í-bòt	ú-bók	é-bé	fük
Okobo	ú-búgù	ú-bók	é-bá	bàt
Oro	ú-búgò / m-	ú-bók / ɔ-	é-bé	bàt
Uda	ú-búrù	ú-bó?	é-bé	bàt
Ukwa	í-búòt	ú-bók	é-bá	bàt
Usakade	ú-βò / m-	ú-βók / a-	é-βá / a-	bà (-sé)
PLC	*ú-búgòd / m-	*ú-bók / a-	*é-bá / a-	*bàd
PUC	-ttó (D)	*kò-bók / i- (D)	*dè-báj / dà (D)	--
Og	--	*ɔ-bá	--	--
CD	--	à-vò	--	wal

Table 4.2g: Evidence for reconstructing PLC \*b.



and [b] exists in all of the daughter languages, there is also a variety of reflexes. Most of the changes in evidence represent instances of reduction, with PLC \*b becoming [β], [w], or [v] (or a tapped stop, [b̤]). Exceptions to this are the 'regular' change of PLC \*b to Ibino /p/, and the 'sporadic' change in Ebughu of \*b > [gb]. The most regular development is that of PLC \*b > β / V\_V in Usakade. PLC \*/b/ has been maintained in Usakade when it occurs word-initially (e.g., in imperative verb forms), and following syllabic n ([m-]). The reason for the nasal imparting a certain stability to the following stop would obviously not be the same as that discussed above for [gʷ] > [ŋʷ]; the influence of the nasal in the two cases is returned in Chap. 5. The reduction of PLC \*/b/ has taken the same course in many of the languages, resulting in [β], [w], [v], etc., as mentioned. However, for the most part these have been independent developments in the different languages, as quite often it is different lexical items which are affected, though the mediating environment seems to have been the same, namely, generally intervocalic and before rounded vowels for [w].

The fact that changes in PLC \*/b/ have not been entirely regular suggests two possibilities: first, that this may be evidence of two phonemes rather than one at the PLC level - i.e., the fortis/lenis opposition discussed earlier. This would suggest that the reduced articulations now present are reflexes of one phoneme (presumably the lenis one), and the unreduced ones, i.e., a full labial stop, are reflexes of the other, presumably fortis, phoneme. For this to have much credibility, however, one would first of all like to see a large degree of concurrence of reflexes across the group; this is not the case. Second, one would hope for a degree of concurrence between developments in Lower Cross and the reconstructed system of Upper Cross with regard to the fortis/lenis distinction. This also is not the case; Sterk (n.d.), for example, reconstructs PUC \*-bèn 'husband', which is cognate with PLC \*è-bét, but PUC \*-bbód 'goat', which is cognate with PLC \*é-bót (the doubled 'b' represents fortis). Both the Lower Cross words show similar developments across the group, suggesting that if Sterk's reconstruction is accurate, then the fortis/lenis distinction disappeared pre-Lower Cross. The situation is in fact more complicated, in that not only are there discrepancies in this regard between the two existing reconstructions of PUC (as mentioned above), but there are at least three reconstructed labial phonemes for PUC which correspond to PLC \*b; PUC \*b, \*bb, and \*p. Nor is there an apparently straightforward correspondence between PUC \*pp and \*p on one hand, and PLC \*f and \*b on the other (see below).

The other possibility to account for the apparent lack of regularity of the reduction of PLC \*b, is to look at this development from the perspective of lexical diffusion. The change of PLC \*b to [w], for example, has affected different dialects of Anaang to varying degrees, suggesting that it is a change in its implementation stage, a 'sound change in progress'. The same can be said of the development of \*/g<sup>w</sup>/ > [w], which has also affected Anaang dialects to different degrees, and it would be of interest to discover what sort of interaction, if any, exists between the two developments. Certainly a quantitative study of this variation would prove revealing.

Finally, the change of \*/b/ > /v/ in Enwang and Uda partially parallels the \*/b/ > /w/ development in Ebughu (i.e., there is an overlap in the sets of lexical items in which the two developments occur), but not enough to suggest a period of common development for the three (which would imply an intervening 'v - stage' for Ebughu). It does imply such a period for Enwang and Uda, but it is not clear whether that period is to be considered to be now (the two groups inhabit contiguous areas and interact substantially) or some time in the past. If quantitative studies were to show that this is a change which is currently spreading in a similar way in both languages, it would suggest that this is their period of common development. This is supported by the change of PLC \*/kp/ in these languages, though the change seems to be complete in Enwang but not Uda.

#### 4.2.4. The development of alveolar stops

Two alveolar (or denti-alveolar) stops existed in Proto-Lower Cross, voiced and voiceless. The voiceless stop \*/t/ is perhaps the most straightforward reconstruction of the system, and as the examples in Table 4.2h demonstrate, it has undergone little in the way of development as the group has diversified. Changes that have taken place have almost exclusively involved palatalization or assibilation (e.g., 'stone' in Obolo and Usakade). In this light, the discussion of the preceding chapter (§3.7), may usefully be recalled, and both the stability of this consonant, and the nature of the variation which has occurred allow us to suggest that the articulation of \*/t/ was essentially the same as that found today in Lower Cross.

In the above examples, PLC \*/t/ has been reconstructed in words where Dimmendaal (or Sterk) reconstructed \*/tt/ in PUC reconstruction. Other examples, not included in the table, again suggest that if the fortis/lenis opposition did exist in Delta Cross, it was lost before the emergence of the Lower Cross languages. These include

	car	tree	sun	stone
Anaang	ú-ṭṣṇ	é-tó	ú-tún / ú-tín	í-tíát
Ebughu	ú-ṭṣṇ	ái-tié	ú-tín	ú-tígé
Efai	ú-ṭṣṇ	í-tí	ú-tín	í-táwí
Efik	ú-ṭṣṇ	é-tó	ú-tín	í-tíát
Ekit	ú-ṭṣṇ	é-tú	ú-tín	í-tié́t
Enwang	ú-ṭṣṇ	í-tí	ú-tín	ú-tígé
Etebi	ú-ṭṣṇ	í-tíó	ú-tín	í-tíát
Ibibio	ú-ṭṣṇ	é-tó	ú-tín	í-tíát
Ibino	ú-tón	í-tíò	ú-tín	í-tíá
Ibuoro	ú-ṭṣṇ	é-tó	ú-tín	í-tíát
Iko	ú-ṭṣṇ	í-tíó	ú-tín	í-tíá
Ilue	ú-ṭṣṇ	é-tí	ú-tín	ú-tái
ItuMbuso	ú-ṭṣṇ	é-tó	ú-tún	í-tíát
Obolo	ú-ṭṣṇ	ú-tĩè	ú-ɬá	é-wú:
Okobo	ú-ṭṣṇ	é-tí	í-tén	í-tígé
Oro	ú-ṭṣṇ / ɔ-	é-tù	ú-tín	ú-tígé / n-
Uda	ú-ṭṣṇ	í-tí	ú-tín	ú-tíké
Ukwa	ú-ṭṣṇ	é-tó	ú-tín	í-tíát
Usakade	ú-ṭṣṇ / a-	ê-tĩ / n-	ú-tín	ú-tʃá
PLC	*ú-ṭṣṇ / a-	*é-tié	*ú-tín	*ú-tígát
PUC	*`-ttṣṇ (D)	*`-tté (S, D)	--	--
Og	*ḡ-tṣ	*e-té	--	--
CD	ə-tò	(ò-rén)	--	--

Table 4.2h: Evidence for reconstructing PLC \*t

	tooth	stream	sheep	come
Anaang	é-ɬèt	í-rìm	é-ròŋ	dí
Ebughu	é-rĩ	ú-rúm	é-ròŋ	dí
Efai	é-dìè	í-dìm	é-dòŋ	dí
Efik	é-dèt	í-dìm	é-dòŋ	dí
Ekit	é-deĩ	í-dìm	é-dòŋ	dí
Enwang	é-dĩ	ú-dìm	é-ròŋ	dí
Etebi	é-dìt	í-dìm	é-dòŋ	dí
Ibibio	é-dêť	í-dìm	é-dòŋ	dí
Ibino	é-dèt	í-dìm	é-ròŋ	dí
Ibuoro	é-dèt	í-dìm	é-dòŋ	dí
Iko	é-dèt	í-rìm	á-ròŋ	dí
Ilue	é-dĩ	ú-dìm	é-dòŋ	dí
ItuMbuso	é-dêť	í-dìm	é-dòŋ	dí
Obolo	é-dzét / é-dzérè	~ òkígwàgwá	á-ròŋ	nă
Okobo	é-rè	ú-ròm	é-ròŋ	dí
Oro	é-dĩ	ú-dìm	ó-dòŋ	dí
Uda	é-rĩ	ú-rúm	ó-ròŋ	dí
Ukwa	é-dêť	í-dìm	é-dòŋ	dí
Usakade	é-dê / a-	ú-dùm / n-	ó-ròŋ / i-	àdí
PLC	*é-dèt / a-	*ú-dìm	*é-dòŋ / i-	*dí
PUC	*sàdò (S)	--	*tònà (S)	--
Og	*à-dá:	--	naanà	du / lu / dzu
CD	--	--	--	-ru / -tu

Table 4.2i: Evidence for reconstructing PLC \*d

'ashes' PLC \*tón, PUC \*-tón (cf. 'ear', in the table), and 'work', PLC \*útóm, PUC \*-tomo. But once again, the situation is not as straightforward as one might hope, as PUC \*tt also corresponds to PLC \*s and \*d, and PUC \*t also corresponds to PLC \*d (all of these according to Dimmendaal's reconstruction; Sterk's gives a different, but equally complicated, set of correlations).

The voiced alveolar stop of PLC is also a relatively straightforward reconstruction for PLC, at least at the phonological level. Determining more precisely what the phonetic nature of the articulation might have been is perhaps less certain than for PLC \*t, but given the developments that PLC \*d has undergone, it is a safe assertion that, as with Ibibio /d/, it must have had a weaker articulation than \*t.

The most important development of PLC \*/d/ has involved a weakening or erosion of the stop articulation to a tap. This was described in the previous chapter, and is returned to again in Chapter 5; here I might simply emphasize that, for the most part, this change of \*d > r has been widespread phonetically, but only in Obolo and Anaang (the Abak dialect) has the tap developed phonemic status alongside /d/. (In fact, my own data do not show this conclusively for Obolo, but see Faraclas, 1984a: xvii - xviii.) In Anaang, the change has been general and unconditioned; it is apparently not the result of a split of PLC \*/d/, and instances of /d/ in the language are the result of a separate development, discussed below. In other Lower Cross languages, this change has spread to varying degrees (i.e., both [d] and [r] exist as variants), with again no readily discernible environmental conditioning factor. At least for Efik, Ibibio, Iko, and Usakade, speakers are aware of this variation, and have a preference for one or other variant within their own speech or language (normally the preference is to claim (orthographic) 'd'), but agreement is not necessarily to be taken for granted (cf. Cook, 1969b: 7-8). The variation might possibly be explained in terms of lexical diffusion theory, and again a quantitative study should shed more light on this matter. The only other developments of PLC \*/d/ are the affrication observed in Obolo, occurring before high front vowels, and the appearance of [ɟ] in Uda and occasionally elsewhere. This latter development in all likelihood had [r] as an intervening stage.

#### 4.2.5. The /d/ - /l/ - /n/ correspondence and the phonemic status of \*/l/ in PLC.

It has been shown that both \*/d/ and \*/n/ are reconstructible for PLC. In a number of the daughter languages, however, /l/ is found as well as /d/, corresponding



to /d/ in the rest of the group (or /n/ in Usakade). In most of the languages, the division of lexical items showing one or the other is clear cut; only in Ibino do both /l/ and /d/ occur in words containing /l/ in other languages. That is, unlike other changes that have been examined (e.g., \*b > w, \*d > r), it is consistently the same set of cognates, across languages, which contains /l/<sup>88</sup>. The change, then, could not be one that has arisen independently in the different languages. Either a split (\*d/ > /d/, /l/) or a merger (\*l/, \*d/ > /d/) has occurred (the case of Usakade is discussed below). Typically in cases of historical split, one expects to find, or to be able to reconstruct, evidence of a conditioning environment (e.g., \*/b/ > /β/, /b/ in Usakade, discussed above where the change occurred only intervocalically). In this case, there is no evidence for a split, so it is concluded that a merger has taken place. Table 4.2j provides evidence for this reconstruction. For Ibino, research has yet to be done to ascertain whether the /l/ and /d/ occur in free variation, or whether other factors determine the variation.

The conclusion that a merger has occurred is given credence by the fact that those languages having \*/l/ (Ebughu, Enwang, Ibino, Iko, Ilue, Obolo, Okobo, Oro, and Uda) do not appear, on independent grounds, to form a sub-group within Lower Cross, as would be implied if /l/ were an innovation. On the other hand, those languages exhibiting the postulated merger (i.e., Anaang, Efai, Efik, Ekit, Etebi, Ibibio, Ibuoro, ItuMbuso, and Ukwa) for the most part do appear to be more closely related<sup>89</sup>, both in terms of lexicostatistic comparisons (see Appendix C) and sound correspondences. With regard to sound correspondences, there are at least two which coincide (at least to a large extent, if not perfectly) with the /d/ ~ /l/ divide, namely an u- ~ i- correspondence in prefixes, and the loss of ambisyllabic /k/ word internally in a small, but generally consistent set of words. The former of these (u- ~ i-) is not discussed here to any extent, but see, for examples, the paradigms for 'head', and 'stream' in the preceding tables. The latter is discussed below, but the cognate sets for 'head' and 'stone' also illustrate this correspondence.

---

88 This generalization breaks down for Obolo to a certain extent, but it will be recalled (from the Introduction) that Obolo not only apparently split off from the rest of the group much earlier, but has also been subject to considerably greater external pressures.

89 Efai is perhaps anomalous in this respect, in that geographically, at least, it is somewhat isolated from the rest of this central group. Certain oral traditions, at any rate, also support the notion that Efai has closer connections historically with the languages mentioned than it might have at present.

	tongue	sleep (n)	bite (v)	ten
Anaang	é-démè	í-dáp	dóm	dùòp
Ebughu	é-lěĩ	í-lé	ló	lùgò
Efai	é-dɔĩ	í-dé	dó	dùgù
Efik	é-démè	í-dáp	dóm	dùòp
Ekit	é-ďie	í-déε	dú	dùgò
Enwang	é-!dé-lěĩ	í-lé	ló	lùgù
Etebi	é-ďĩ	í-dé:	dú	dùgù
Ibibio	é-démè	í-dáp	dóm / díim	dùòp
Ibino	é-lôm / é-dómò	í-lá:p	lóm	lùòp
Ibuoro	é-démè	í-dáp	dóm	dùòp
Iko	é-lôm	í-lá:p	lóm	lùòp
Ilue	é-láĩ	í-lé	ló	lògù
ItuMbuso	é-démê	í-dáp	dóm	dùòp
Obolo	á-lóm	í-lá:k	lóm	àkòp
Okobo	é-láĩ	í-lé?	ló	lùgù
Oro	é-lěĩ	í-lé	ló	lùwù
Uda	é-lěĩ	í-lé:	ló	lùgù
Ukwa	é-dêm	í-dáp	dóm	dùòp
Usakade	é-nêm / a-	í-náí / o-	nóm (-dá)	nùòp
PLC	*é-lémè / a-	*í-lá:p	*lóm	*lùgòp
PUC	(*-mèdà (S))	*-dábí (D)	*dómá (S)	*djò:bí (S)
Og	** -dēm	** -dá:	**dũm	**lo?òb
CD	**àlèm	**àdàlà	**lom	**đíòß

Table 4.2j: Evidence for reconstructing PLC \*l

Despite strong evidence for PLC \*/l/, the alternative of reconstructing the third participant in the /d/ ~ /l/ ~ /n/ correspondence should also be discussed. It is, in fact, a more difficult scenario to conjecture. In this case, it would first of all be necessary to explain the split that would have happened, i.e. \*n > n, d or \*n > n, l, when again there is no obvious conditioning environment, and second, to explain why some languages of the group have /d/ as a result of what would be a denasalization process whereas others have /l/. Indeed, it may be wondered why denasalization would occur at all in a set of words many of which contain nasal consonants. Understanding \*/l/ > /n/ is perhaps more straightforward in that, apart from acoustic similarities, the /n/ reflex can to a certain extent be seen as an areal or substratum phenomenon. That is, the dialect of Balondo which forms a strong substratum in the history of Usakade has no /l/; in addition, /n/ apparently frequently occurs as a reflex of \*/L/ in many of the surrounding Grassfields, Ekoid, and Narrow Bantu languages (Miehe 1985).

Certain aspects of the comparative data from other Delta Cross languages need also to be discussed, particularly in view of the fact that for most of these it has seemed more appropriate to reconstruct \*/d/. In many of these cases (especially for Upper Cross) there is a plethora of reflexes (e.g., d, r, l, j), making the reconstruction difficult at best (the data provided by Dimmendaal, for instance, often gives no clear picture of the basis of his reconstruction). And in cases which are seemingly more straightforward, researchers have often chosen to reconstruct \*/d/ on the grounds first, that it often is the more frequently occurring of the two, and second, that d > l is seen as a weakening, and consequently phonetically more plausible, and therefore a more plausible development.

The first of these grounds is of course simply inadequate as a basis for reconstruction - although it may serve as a starting point in many cases, there is no *a priori* reason why 'majority rule' should be a principle governing phonological reconstruction. In the second case, granted that 'weakening' changes appear to be far more common than 'strengthening' or 'hardening' changes, this should not be taken to imply uncritically that they are phonetically more plausible (but cf. the discussion of Pagliuca and Mowrey's work in Chapter 5). More to the point at hand, it is by no means clear that d > l is in fact 'weakening'; whether or not this is the case would

presumably depend on the phonetic characteristics of the specific [d] and [l] in question<sup>90</sup>.

Returning to the reconstruction in hand, it may also be worthwhile bringing to bear evidence from further afield. Certainly in the Bantu languages, words cognate to those reconstructed with PLC \*l can be found with /l/ in some cases, and /d/ in others. Traditionally, Bantuists have reconstructed PB \*/d/ in these cases (e.g., Guthrie 1967 - 1971), but it is clear Bantu reconstruction needs rethinking in more than just this regard (cf. Hedinger 1987, Stewart, 1989). Further afield still, one finds in various languages more distantly related, cognate words containing /l/. I take as examples words from Samba Leeko, an Adamawa language spoken in the Mambila region of the Nigeria-Cameroun borderland: 'louse' PLC \*láj, SL láágá; 'bite' PLC \*lóm, SL lum-; 'eat' PLC \*líá, SL líí- (Noss 1976). Indeed, one could go even further yet, as in Kordofanian languages we also find 'bite' /lami/, 'buy' /la/, and 'eat' /le/ (these data from Greenberg 1963). From evidence of this sort, it would appear that PLC \*/l/ goes back to a very early stage.

Finally, a comment on the situation of Ibino. As was mentioned above, in certain of the '/l/ - words' either [l] or [d] may occur (e.g., 'tongue' élôm ~ élómò ~ édómò) and in others typically only /d/ (at least in my own data - e.g., 'body' ídé, but PLC \*ídém). It is possible that instances of [d] (= /d/) are recent developments, a result of influence both from neighbouring Ekit and prestigious Efik, or perhaps the last stages of the postulated historical merger. A second option would be to view these as long-standing alternations, resulting from Ibino, as a fishing community, being settled by various Lower Cross groups, some of whom would have been original '/l/-speakers' and others '/d/-speakers'. There is some support for this hypothesis in the oral traditions of the region (Connell and Maison forthcoming).

#### 4.2.6. Palatals

One palatal stop, \*/j/ has been reconstructed for Proto-Lower Cross. This together with the velars (see next section) is one of the more difficult areas for PLC reconstruction, however, the correspondences [j ~ dʒ ~ dʒ ~ tʃ ~ z ~ jɿ] in Table 4.2k

<sup>90</sup> Electropalatography, for example, reveals considerable variation as to the amount of linguo-palatal contact involved in the production of these consonants; it is not inconceivable that [l] could involve greater contact than [d] in a given language, thereby making it the stronger of the two (assuming, not unreasonably, that degree of contact is an acceptable correlate of 'strength').

	fish	steal	full	child
Anaang	í-dʒák / í-ják	dʒɪp	á-dʒɔ́wɔ́	á-dʒén
Ebughu	é-ják	dʒɪp	ò-jɔ́Rò	ú-jétò
Efai	é-ják	jɪp		á-jùtò
Efik	í-ják	jɪp	ò-jÓRò	é-jén
Ekit	í-já? / í-dʒá?	dʒɪb	á-ljó?	á-zú
Enwang	í-ják	jɪp	ɔ́-ljɔ́Rɔ́	è-tàg é-jò
Etebi	í-já	dʒɪp	à-jòʔ	á-dʒó
Ibibio	í-ják	jɪp	à-jɔ́wɔ́	á-jín / ò-dítò
Ibino	á-tʃák	tʃɪp	ò-tʃɔ́Rɔ́	ó-tʃíó / ò-dítò
Ibuoro	í-ják	jɪp	à-jɔ́wɔ́	é-jén
Iko	é-zák	zəp	â-zÓRó	é-dʒíó
Ilue	é-ják	jɪp	ɔ́-ljɔ́wɔ́	ɔ́-jó
ItuMbuso	í-ják	jɪp	ɔ́-ljɔ́Rɔ́	é-jén / òtítɔ́:
Obolo	í-ɸɪŋ	tʃɪŋ	í-dʒòt	gʷúŋ / ò-sàbón
Okobo	í-ják	jɪp	ò-jɔ́Rò	á-jó / ò-dítújò
Oro	á-ják	dʒɪp	ɔ́-ljɔ́k	ɔ́-jɔ́
Uda	í-já?	jɪp	ɔ́-ljɔ́Rɔ́	ɔ́-jɔ́
Ukwa	í-ják	jɪp	ɔ́-ljɔ́wɔ́	é-jén
Usakade	ɔ́-réné émòŋ / i-	jɪp (-dá)	jɔ́k	ó-jén / e-
PLC	*é-ják / i-	*jɪp	*jɔ́k	*ɔ́-jén / ɛ-
PUC	--	*ssíbó / djíbà	*ssí- / juka	--
Og	jǎǎ	zɪb / dʒɪ / jɪb	--	--
CD	--	íjɪ	--	òɲì

Table 4.2k: Evidence for reconstructing PLC \*j

indicate a phoneme articulated in the palatal zone. Exactly what its phonetic realization was, however, is difficult to reconstruct. If one holds to the accepted wisdom that sound change is by and large a weakening process, then either of the two affricates would be strong candidates, perhaps preferably [tʃ]. On the other hand, synchronic variation within the group lends at least some support to reconstructing [jɹ].

Throughout most LC languages, the normal realization of this phoneme is [jɹ], and in some, [dʒ] or [dʒ], or rarely [j] (see §3.7). For speakers normally having [jɹ], speech styles exist - e.g., excited or emphatic speech - where the voiced affricate is often realized. This is the type of synchronic variation Pagliuca and Mowrey (1987: 459) apparently consider desirable to support postulating fortition diachronically, and indicates that [jɹ] could be reconstructed. Such a reconstruction would also be favoured by those who accept a simple 'majority rule' principle. However, as Tom Cook has pointed out (personal communication), there is no *a priori* reason why the innovation, rather than the retention, should appear in the exceptional speech styles, and such evidence could equally well reflect a lenition process, with the historically older form turning up in the exceptional styles.

The existence of [tʃ] in Ibino, however, provides what is perhaps the best clue to what is the most appropriate reconstruction. It has been seen already that Ibino has devoiced initial obstruents - e.g., PLC \*b, \*g<sup>w</sup> > Ibino [p], [k<sup>w</sup>]. The occurrence of [tʃ] in Ibino parallels that of [p] and [k<sup>w</sup>] - i.e., with voiced and sometimes reduced articulations corresponding elsewhere in the group. In these two instances, there was no evidence to support reconstructing the voiceless phoneme, and it is therefore reasonable to suggest a leniting process has indeed occurred (or is occurring) here as well; i.e., that the devoicing process in Ibino occurred not to individual segments, but to all voiced obstruents in a initial position. The existence of [j], albeit infrequent, leads to a reconstruction, then, of PLC \*j. This reconstruction allows us to adhere to the expected lenition process, except with regard to the devoicing in Ibino, as this is frequently considered to be a strengthening process. This assumption regarding voicing, though, is a debatable one, and it has already been shown that Ibino is exceptional in this regard.

Finally, although PLC \*j is therefore the preferred solution, one last aspect may be mentioned. Similar developments can be seen in the neighbouring and related Ogoni languages (i.e., a [z ~ dʒ ~ j] correspondence), which suggests that either these



languages are undergoing developments similar to those in Lower Cross, or that perhaps the variation seen in both groups is in fact quite old. That is, it may have existed not only in PLC, but perhaps even in Proto-Delta Cross as well.

It may seem counter-intuitive, and somewhat against phonetic principles to reconstruct a lone voiced stop in this articulatory zone. There is some evidence that \*/c/ should also be reconstructed for PLC, however this evidence is ambiguous at best, and an alternative solution, at least pending an appropriate reconstruction of PLC vowels,<sup>h</sup> has been adopted. This is discussed in the following section.

#### 4.2.7. Voiceless velar stops

As mentioned, one of the more interesting areas for consonant reconstruction in PLC is that involving a velar articulation. Faraclas (n.d.) postulated voiced and voiceless velars, labialized velars and labial-velars, implying that the situation as it currently exists in Obolo reflects that of the proto-language. However, there seems to be little convincing evidence for the establishment of voiced phonemes at a velar place of articulation in the parent language, and the present reconstruction postulates only voiceless velars. Table 4.21 presents evidence for the establishment of PLC \*/k/ (= [k, c]).

From this evidence, \*/k/ is clearly reconstructible; several correspondence sets exist across the group which leave this uncontroversial. Where the reconstruction may be more debatable is in the treatment of correspondence sets showing a range of reflexes, such as that shown in the cognate sets for 'one', 'heart', 'shin', 'insult' and 'guest' (see Appendix A), or the correspondences between [k] and [g] or [k] and [kʷ] (which exist mainly between Obolo and the rest of the group, but see §3.7). For these see, e.g., 'beans', 'mother', and 'bee' in Appendix A. If the reconstruction is to be accepted, the decision not to reconstruct PLC \*/kʷ/, \*/g/, and possibly \*/c/ must be justified.

The suggestion that there was a voiceless palatal stop in the parent language, and that it was this that developed into some of the present day range of alveolar and palato-alveolar fricatives and affricates, is tempting, particularly in considering (as well as 'one', etc., mentioned above) the cognate set for 'insult (n.)' (Appendix A). This has, in most LC languages, the root /-sɔŋ/ corresponding to /-tʃɔŋ/ in Anaang, Ibino, Iko, Obolo, Okobo, and Usakade, suggesting PLC \*/-cɔŋ/. Only Ilue and

ItuMbuso /-kíóŋ/ ([cíóŋ]) provide a clue that PLC had \*/-kíóŋ/ (\*[cíóŋ]) rather than \*/-cóŋ/. Even considering this, though, if one were to reconstruct PLC \*/c/, it would leave evidence of PLC \*/k/ having occurred only in back and/or low vowel contexts. So while there may be some indication that PLC \*/c/ could be reconstructed in a variety of environments (possibly before both front and back vowels), the evidence is not strong, and its implications for the distribution of PLC \*/k/ are unacceptable. It appears, therefore, that PLC \*/k/ has straightforwardly undergone palatalization, and affrication/assibilation before front vowels in most of the group. The velar articulation has been retained primarily in Ibino, Iko, Ilue, ItuMbuso, and Oro, as indicated by the paradigm for 'heart'<sup>91</sup>. That it has been retained may plausibly be tied into developments in the vowel systems of these languages, in that the following vowel in all of these but ItuMbuso is no longer high front [i], but has become lowered and centralized [ɪ], as shown in the transcriptions e.g., for 'heart'. In other words, what was PLC \*[ciC] has become [kɪC] in this set of the languages. (ItuMbuso has [ciC].) A more confident statement as to the possibility of reconstructing PLC \*/c/ awaits a reconstruction of the vowel system.

The possibility of reconstructing PLC \*/kʷ/ is less likely, but still warrants consideration. Both Obolo and Ibino have /kʷ/, but not in corresponding items. In Ibino, most instances of /kʷ/ are reflexes of PLC \*/gʷ/ (see below). In Obolo /kʷ/, apparently has a variety of sources. Some instances seem to be reflexes of PLC \*/kp/ (see below), and others may be a result of borrowing, though there are no clear instances of this. More interesting ones, however, would appear to result from independent developments within Obolo, and can be seen as a result of phonological restructuring. An examination of the various reflexes of PLC \*úkuàk 'metal' (see also 'music/song', 'toad', and 'bee', Appendix A) is suggestive as to how this development might progress, i.e., by the gradual reduction of vowel clusters, leaving the labialization of the following vowel associated with the consonant. This question is returned to in Chapter 5. One further aspect that should be considered here is the possibility of correspondences between what has been reconstructed as PLC \*/k/ and a /k/ ~ /kʷ/ opposition elsewhere as, for example, has been reconstructed for PUC. There are several examples of both PUC \*/k/ and \*/kʷ/ corresponding to PLC \*/k/

<sup>91</sup> The retention of PLC \*/k/ is more widespread in some words than others, suggesting that lexical diffusion is playing a role in its evolution. Its greater retention in 'one' than most other words with the appropriate environment may be accounted for from this perspective. Cook (personal communication) has suggested that numerals, particularly the lower ones, may be more resistant to change, due to their frequency of use, e.g., in trade situations.

	leg	bush / farm	think	fire
Anaang	ú-kót	í-kót	kéré	í-kán
Ebughu	ú-kúó	ú-kó	kré	ú-kán
Efai	ú-kúó	í-kó	kéré	í-kán
Efik	ú-kót	í-kót	kéré	í-kán
Ekit	ú-kó <sup>u</sup>	í-kó?	kóré	í-kán
Enwang	ú-kú	ú-kó	kóré	ú-kán
Etebi	ú-kó?	í-kó?	kré	í-kán
Ibibio	ú-kót / ú-kót	í-kót	kéré	í-kán
Ibino	ú-kót	í-kót	kéḡ	í-kán
Ibuoro	ú-kót	í-kót	kéré	í-kán
Iko	ú-kót	í-kót	kéré	í-kán
Ilue	ú-kú	ú-kó	ké	ú-kán
ItuMbuso	ú-kót	í-kót	kéré	í-kán
Obolo	ú-kót	ú-kó / ó-rôn	kéik	ú-kán
Okobo	ú-kú	ú-kó	kóré	í-kán
Oro	ú-kú / o-	ú-kó	kídé	é-kán
Uda	ú-kú	ú-kó	kéré	ú-kán
Ukwa	ú-kót	í-kót	kéré	í-kán
Usakade	ú-kó / a-	ú-kó	kéré (-dá)	ú-kán
PLC	*ú-kót / a-	*ú-kót	*kéré	*ú-kán
PUC	--	*-kót	*kkétté / kédí	--
Og	--	--	bùrà	--
CD	-wèl	--	--	--

Table 4.21: Evidence for reconstructing PLC \*k

(e.g., 'fire' PUC \*-kʷɔ́ɲ, PLC -kán; 'bush' PUC \*-kɔ́t, PLC \*-kɔ́t; 'grind' PUC \*kʷò:kkí, PLC \*kɔ́k), suggesting that either an earlier distinction was lost by the time of PLC, or that the appearance of the opposition was a development of PUC. There is little evidence from either of Ogoni or Central Delta languages to shed light on this, but there appears to be no such opposition in those languages synchronically.

The existence of voiced velar stops in Obolo and other LC languages (see §3.7) again cannot be taken uncritically as evidence for PLC \*/g/, but neither should the possibility be ignored. First, while there is some correlation between occurrences of [g] in Obolo and Iko, and between occurrences of [g] in Oro and Ebughu, a similar correlation does not exist between these two pairs of languages. Occurrences of [g] in Ebughu and Oro seem most clearly to be a result of an increasing tendency to voicing, as was described in §3.7, though the same cannot be said with such confidence for Obolo and Iko. For Obolo, it is sometimes difficult to establish with certainty cognates elsewhere in Lower Cross for words containing /g/, and therefore the PLC status of /g/. It is possible, however, that more data would prompt a re-evaluation of these conclusions in favour of reconstructing PLC \*/g/.

Finally, the possibility of reconstructing fortis PLC \*/kk/ was also considered. For reasons already discussed (§4.2.1) the possibility of a fortis ~ lenis opposition in PLC has been rejected. The correspondences that might lead one to want to reconstruct PLC \*/kk/ in particular (cf. Faraclas n.d.) are accounted for by the palatalization of PLC \*/k/ discussed in the previous paragraphs.

#### 4.2.7. Labial-velar stops

As with the simple velars, the question as to whether or not a voicing opposition for labial-velar stops can be reconstructed arises, and, as with the simple velars, it was decided not to reconstruct a voiced labial-velar. The voiceless labial-velar stop /kp/ is reconstructible for PLC, though it has undergone a number of developments. The examples in Table 4.21 provide evidence for this reconstruction, and at the same time give an indication of the range of developments PLC \*/kp/ has undergone. In several of the languages, \*/kp/ has lost its velar element, i.e., in Anaang (dialectally), Ebughu, Enwang, ItuMbuso (partially), Okobo, and Uda (partially) \*/kp/ > /p/, and in Usakade \*/kp/ > /b/, while in Obolo, PLC \*/kp/ has, in some items, gone to /gb/, and in others, to /kʷ/. Both of these developments in Obolo appear to be variable across dialects.

	bag	bone	leopard	die
Anaang	è-kpàt	á-kpó	é-kpè	kpá
Ebughu	è-pè	ó-pó	é-píè	pé
Efai	è-kpè	ó-kpó	é-kpĩ	kpá
Efik	è-kpàt	ó-kpó	é-kpè	kpá
Ekit	è-kpàt	á-kpó	é-kpěĩ	kpá
Enwang	è-pè	ó-pó	é-pè	pá
Etebi	è-kpàt	á-kpó	é-kpĩ	kpá
Ibibio	è-kpàt	á-kpó	é-kpê	kpá
Ibino	è-kpà	ó-kpó	é-kpè	kpá
Ibuoro	è-kpàt	ó-kpó	é-kpè	kpá
Iko	è-kpà	ú-kúp	é-kpè	kpá
Ilue	è-kpè	ó-kpó	é-kpĩ	kpá
ItuMbuso	è-kpàt	ó-kpó	é-kpê / é-?pê	kpá
Obolo	à-kpà	ú-kwú:k / ú-kúp	é-gbè	kwù / gwù
Okobo	è-pà	ó-pó	é-pĩ	pá
Oro	è-kpè	ó-kpó / i-	ó-kpĩ	kpá
Uda	è-kpè	ó-pó	á-pĩ	bá
Ukwa	è-kpàt	ó-kpó	é-kpè	kpá
Usakade	è-bà / a-	ú-síp / n-	ó-bê / i-	bá
PLC	*è-kpàt / a-	*ó-kpó	*é-kpè / i-	*kpá
PUC	* -kpà (D)	* -kúpà (D)	* -kpè (D)	*kwá (D) kpá (S)
Og	--	* -kpógó	*mè-kpěè	--
CD	-kpà (è-ḡà)	ò-kpò	--	--

Table 4.2m: Evidence for reconstructing PLC \*kp

The existence of both /kp/ and /gb/ in Obolo corresponding to /kp/ elsewhere could, at first glance, suggest the possibility of an earlier voicing opposition, as could the situation in Usakade, where, along with the /b/ reflex, there are also instances of /kp/. However, apart from the lack of correspondence between the opposition in Obolo and that in Usakade, only very few of the lexical items in Obolo containing /gb/ have cognate forms elsewhere in Lower Cross; the rest are possibly borrowings from neighbouring non-Lower Cross languages (e.g., *ógbó* 'curse' (n.) which is not cognate with known Lower Cross forms, though if it is borrowed, it is not known from where). On the other hand, many more cognates between Obolo and the rest of the group exist for /kp/. It is arguable, then, that /gb/ in Obolo is to a large extent a borrowed sound<sup>92</sup>, and that its perseverance is due, in part, to the partially-voiced quality of LC /kp/. But, as was the case for /g/, it is possible that more data would lead to different conclusions.

In Usakade, /kp/ is found in opposition to /b/, both corresponding to /kp/ elsewhere in the group. In the absence of an apparent conditioning environment that might have precipitated a split, a reasonable hypothesis would suggest that this is evidence for two phonemes in the proto-language, i.e., \*/kp/ and \*/gb/. If there were any correspondence between the situation in Obolo and that in Usakade, the evidence for PLC \*/gb/ would be strong indeed. There is, however, none. Another possibility for Usakade, which is preferred here, is that those items in Usakade which contain /kp/ have been borrowed into the language subsequent to the change of PLC \*/kp/ to Usakade /b/. This is supported by the fact that all 'kp-words' in Usakade come in the o- / i- gender in the language's noun classification system (Connell 1987a), which appears to be the gender into which borrowings are grouped<sup>93</sup>. Such a development is made more plausible by the fact that most speakers of Usakade also speak Efik, which would have been the 'donor' language.

Finally on this question, we may look at evidence from outside the immediate LC group, from its near neighbours. In at least some languages in each of the other three Delta Cross groups, a voiced / voiceless opposition for labial-velars can be found

---

<sup>92</sup> I have suggested borrowing as a influencing factor on Obolo in a number of instances. This raises the question as to why Obolo would have been more greatly influenced in this manner than other LC languages. In the Introduction it was pointed out that, being on the fringes of the LC-speaking region, Obolo is subject to much greater contact with non-Lower Cross languages than any of the others.

<sup>93</sup> This conclusion comes following a discussion with T.L. Cook.



synchronically, and one has been reconstructed for Proto-Ogoni (Williamson n.d.) and for Proto Upper Cross (Sterk n.d., Dimmendaal 1978). Nowhere in the data available to me is there evidence to point to an early merger of this opposition in Lower Cross; in fact the evidence points more to the conclusion already reached, that occurrences of /gb/ synchronically in LC (whether in Obolo or elsewhere) are the result of secondary developments. This is indicated in the examples from these groups included in Table 4.2.12.

Turning to those languages mentioned above where PLC \*/kp/ has evolved into a simple labial articulation, we see that in most of these (i.e., the Ikot Ekpene dialect of Anaang, Ebughu, Enwang, Okobo and Usakade) the change has affected all instances of PLC \*/kp/, suggesting, in traditional terms, an unconditioned change. In Uda and ItuMbuso the change has not affected all items. In fact, for one of my informants from ItuMbuso, pronunciation of individual words was variable between [kp] and [p], while for the other (the older of the two), only [kp] was used. For both of these languages a survey from the point of view of propagation of sound change (i.e., lexical diffusion) would prove interesting.

In Obolo \*/kp/ has been maintained most consistently in the environment of low vowels. When followed by the high vowels [i, u], a change to [k<sup>w</sup>] seems to be spreading, though differentially according to dialect: e.g., Ikuru íkpí, but Asarama ík<sup>w</sup>í 'rat' (PLC \*ékpí), but Ikuru ík<sup>w</sup>ílák, Asarama ḡníkpílá: 'bed'. Other possible examples are ú-k<sup>w</sup>ú 'bone' (PLC \*ó-kpó), and k<sup>w</sup>éḡ 'teach/learn' (PLC \*kpé:p), assuming these are cognate. The latter of these suggests the development is becoming generalized beyond the [i, u] environment. Other examples which can be found in Appendix A. Reasons why high vowels should be involved in the change are explored in Chapter 5; for now we may simply note that the impression of labialization accompanying these stops in other LC languages is most prominent on mid and high vowels (e.g., in Oro).

Finally, the range of reflexes found for PLC \*/kp/, together with the phonetic description given for /kp/ as it occurs synchronically in the group (Chap. 3) allows for comment on the possible phonetic nature of PLC \*/kp/. Essentially, it can be argued, this stop must have had a realization similar to what obtains in the group today, in particular Ibibio. The existence of an asynchrony in the timing of the two articulations, with the labial release occurring later would account for the prevalence of simple labials

among the reflexes, while a voiced release would account for the change to [b] in Usakade. Possible variation across emerging Lower Cross dialects with regard to the extent of voicing prior to the release, similar to the variation currently found in Ibibio would account for the existence of both [p] and [b] as reflexes of PLC \*/kp/<sup>94</sup>.

#### 4.2.8. Labialized velar stops

I have argued above against reconstructing \*/kʷ/ for PLC. It is possible, though, to reconstruct a voiced labialized velar stop, PLC \*/gʷ/. For the most part, PLC \*/gʷ/ has either been retained, or eroded to /w/. In Ebughu and Ibino, however, it has strengthened, though differently in each case. In Ibino, \*/gʷ/ has devoiced to become /kʷ/ quite regularly (only one counter-example to this regular development exists in my data). In Ebughu, the consonant has remained voiced, but the labial articulation has strengthened, resulting in [gb] in certain items, e.g., gbè 'paddle' (PLC \*/gʷət/), [b] in others, e.g., bó 'show' (PLC \*/gʷót/), while remaining [gʷ], e.g., gʷók 'swim', or going to [w], e.g., wàk, 'scratch' (PLC \*/gʷàk/) in others. This again may be a case of a change spreading through the lexicon gradually, as there is no readily apparent conditioning factor governing the variation, and a survey to ascertain whether or not this is the case would be usefully undertaken. These developments, together with evidence for the reconstruction, are illustrated by the data given in Table 4.2m.

It was mentioned earlier that [gʷ] was nasalized in stems containing a nasal consonant, and that this process likely occurred pre-Lower Cross. There is some evidence, though, to question whether this nasalization process was complete by the time of the break-up of PLC. Particularly in the paradigm given for 'person' we find evidence that the process was still underway after the splintering of the group, if we can consider these forms to be cognate (Obolo éñè, is more probably cognate with -dèn, 'man' as found in several of the Central Lower Cross languages; the PLC form reconstructed here can still be found in Obolo in a number of compounds, though, such as 'guest' ògʷò ítfèñ, and 'doctor' ògʷò áfià). If this is true, then we find the process attested in various states - retention of the final nasal without having caused nasalization of /gʷ/ (ItuMbuso and Usakade, though with secondary loss of the velar closure), loss of the final nasal without having brought on nasalization of /gʷ/ (Anaang; also Efik,

94 Another possible explanation for [p] vs [b] is phonological rather than phonetic. In Anaang, etc., a change to [b] would have resulted in a merger with existing /b/. In Usakade, however, it will be recalled that PLC \*/b/ changed to /β/; assuming this change had occurred prior to the labial-velar change, there would be no internal pressure to inhibit the change to [b]. There is at present no independent evidence to allow for the establishment of the relative chronology of these changes.

	paddle (v.)	swim	suck	person
Anaang	gʷɔ̃t	gʷók	gʷóp / gʷóp	á-gʷó
Ebughu	gɔ̃è	gʷók	gbé	á-ŵí
Efai	wè	wók	wé	á-ŋwé
Efik	wàt	wók	wóp / fíp	ó-wó
Ekit	wàt	wók?	wé? / fíp	á-ŋwé
Enwang	gʷè	wók	gʷé	á-ŵú
Etebi	wò	wók?	gʷé	á-ŋwé
Ibibio	wàt	wók	wóp / fíp	á-wó
Ibino	kwàt	kwók	kwóp	é-ŋwé
Ibuoro	wàt	wók	wóp	ó-wó
Iko	gʷàt	gʷók	ŵóp	é-ŋwé
Ilue	gʷè	gʷók	gʷé	ó-ŵú
ItuMbuso	wàt	wók	wóp / fíp	ó-wóm
Obolo	kóp	gʷók	fíp / ŋwóp	é-nè (ò-gʷó ~)
Okobo	wè	wók	wé	á-ŵé
Oro	wè	wók	wé	ó-ŵí / e-
Uda	gʷè	wók	fíép	ó-ŵú
Ukwa	wàt	wók	gʷóp	ó-wó
Usakade	wà		wáp (-sé)	ó-wóm / e-
PLC	*gʷàt	*gʷók	*gʷóp / *fíp	*ó-gʷóm / e-
PUC	--	*gʷók (D)	--	(*nèt (S))
Og	kwɔ̃	--	--	--
CD	--	--	--	--

Table 4.2n: Evidence for reconstructing PLC \*gʷ

Ibibio, Ibuoro, and Ukwa, though with secondary loss of the velar closure), and nasalization of /g<sup>w</sup>/ with subsequent loss of the final nasal in the others. Although the reconstruction of PLC \*ó-g<sup>w</sup>óm for 'person' looks plausible, and therefore also the implied developments, it needs to be pointed out that there are no other items that parallel this, leaving it still as a somewhat questionable reconstruction. This of course does not call into question the reconstruction of PLC /g<sup>w</sup>/; the other examples given provide ample evidence for it.

### 4.3. Fricatives

#### 4.3.1. Labials

All Lower Cross languages have at least two fricatives, /f/ and /s/; the first of these is relatively straightforward to reconstruct for PLC. Only in Obolo has PLC \*/f/ undergone regular change, where \*/f/ > /w/ in most environments, as shown Table 4.3a, (cf. also 'want' - Obolo wěk, Ibino, Iko fét) but has palatalized when followed by a high front vowel - cf. 'moon', and also 'rub', Obolo tʃíók, but fíónó elsewhere in the group.

Comparison of PLC forms with those from the related groups shows that PLC \*/f/ probably comes from an earlier labial stop. Only three cognates, one from each of the three other groups are found corresponding to the words in the table, but cf. also 'jump': PLC \*fàrɔ́, PUC \*pé, Og \*pɛɛ, and CD (Abua, etc.) -pɛl. Other labial fricatives which exist currently in Lower Cross, such as /β/ (in Usakade), and /v/ (Ebughu, Enwang, and Uda), are not reconstructible for PLC.

#### 4.3.2. Alveolars

Reconstructing \*/s/ for PLC is not as straightforward as \*/f/, largely due to an absence of complete cognate sets in the data. The items included in Table 4.3b come close to this, however, and seem to support the reconstruction adequately. This is particularly true of 'face', which probably best reconstructs for PLC as ísóépèn, a compound perhaps of an earlier form for 'head' (cf. CD -íši-, Igbo ísí, etc.) and 'eye', épèn, as is still found in Iko today. This apart, the cognate sets for 'housefly' and 'day' (giving PLC \*ú-sùŋ ~ and \*ú-sèn, respectively) also give evidence for PLC \*/s/.

When forms from outside the group are also taken into consideration, the paradigm for 'walk' in particular, but also that for 'fly', some indication of the provenance of PLC \*/s/ is gained, suggesting it has come from an earlier (PDC) \*/k/ or

	house	moon	crocodile	forget
Anaang	ú-fòk	á-fíóŋ	à-fiòm	fíré
Ebughu	ú-vòk	ó-fíóŋ	à-fəŋĩ	frě
Efai	ú-fòk	á-fíóŋ	à-fəŋĩ	frě
Efik	ú-fòk	ó-fíóŋ	ò-fiòm	frě
Ekit	ú-fà	á-fíóŋ	à-fiòm	frě
Enwang	ú-fòk	ó-fíóŋ	à-fəŋĩ	frě
Etebi	ú-fàʔ	á-fíóŋ	à-fiòm	fəré
Ibibio	ú-fòk	á-fíóŋ	à-fiòm	frě / fíré
Ibino	ú-fòk	ó-fíóŋ	ò-fiòm	fɪě
Ibuoro	ú-fòk	á-fíóŋ	à-fiòm	frě
Iko	ú-fòk	á-fíóŋ	à-fiòm	frě
Ilue	ú-fòk	á-fíáŋ	ò-fiŋĩ	fəré
ItuMbuso	ú-fòk	ó-fíóŋ	ò-fiòm	fùré
Obolo	ú-wù	ó-ŋáŋ	à-sàkwún	wú / wùrú
Okobo	ú-fòk	á-fíóŋ	à-fiòm	frě
Oro	ú-fòk	á-fíáŋ	ò-fiŋĩ	frě
Uda	ú-fòk	ó-fíóŋ	à-fəŋĩ	frě
Ukwa	ú-fòk	ó-fíóŋ	è-fiòm	fəré
Usakade	ú-fòk / a-	ó-fíóŋ / i-	è-fièm / a-	fèré (-jà)
PLC	*ú-fòk / a-	*ó-fíóŋ	*ò-fiŋèm / a-	*fèré
PUC	--	*pé (D)	--	--
Og	--	--	pa	--
CD	--	--	--	-bulə

Table 4.3a: Evidence for reconstructing PLC \*f

	face	housefly	day	walk
Anaang	í-só	ú-dzíp / ní-sòŋ	ú-sèn	sàŋjá
Ebughu	á-ŋè	ní-sûŋ ídòŋ	ú-sò	sàŋjá
Efai	é-ŋè	ní-sòŋ	ú-sĩ	sàŋjá
Efik	í-só	ní-sùŋ	ú-sèn	sàŋjá
Ekit	í-sí	ní-sòŋ	ú-sù	sàũjá
Enwang	á-ŋĩ	ní-sùŋ ídòŋ	ú-sè	sàŋjá
Etebi	í-síó	ní-sòŋ	ú-síò	sàŋjá
Ibibio	í-só / í-sí	ní-sûŋ	ú-sên	sàŋjá
Ibino	é-ŋè / í-só	ní-sùŋ	ú-sèn	sàŋjá
Ibuoro	í-só	ní-sùŋ	ú-sèn	sàŋjá
Iko	í-sóé-ŋè	ní-sòŋ	ú-sèn	sàŋjá
Ilue	ó-ŋĩ	ní-sùŋ	ú-sĩ	sàŋjá
ItuMbuso	í-só	ní-sûŋ	ú-sên	sàŋjá
Obolo	í-sí	à-náńdzĩŋ	ú-sèn	dʒè
Okobo	í-só	ní-sûŋ úfòk	ú-sè	sàŋjá
Oro	ó-ŋĩ	ní-sùŋ ídòŋ	ú-sè	sàŋjá
Uda	á-ŋĩ	ní-sóŋ ídòŋ	ú-sè	sàŋjá
Ukwa	í-só	ní-sùŋ	ú-sên	sàŋjá
Usakade	í-só / n-	ú-sûŋ / n-	ó-kú / i-	sàŋjá
PLC	*í-só éŋèn	*ú-sùŋ / n-	*ú-sèn	*sàŋjá
PUC	--	*-kkĩŋjà (S)	--	*kkènjá (S)
Og	togó	*ŋ-kĩ	dee	*cã:
CD	-íĩ-	**è-gì	--	--

Table 4.3b: Evidence for reconstructing PLC \*s



\*/kk/. Further possible evidence for this comes from ‘ground’, PLC \*ísòŋ (perhaps \*ítʃòŋ), which may be cognate with PUC \*kkèk (S). It is not clear whether outside forms for ‘face’ or ‘head’ (see Table 4.2.g) are cognate with PLC \*íso~, but if so, this would suggest that fortis alveolars also may have played a role in the history of PLC \*/s/.

#### 4.4. Approximants

Having reconstructed PLC \*/j/ rather than /j/, the question then arises as to whether approximants can also be reconstructed. There seems to be no evidence for a contrast in initial position between the palatal stop and a palatal approximant, although in other positions the approximant may have existed (e.g. post-consonantly or intervocalically).

Similarly, although /w/ exists synchronically in all Lower Cross languages, there is little evidence in the comparative data to suggest it was present in the parent language as a stem-initial phoneme. It has been shown that instances of /w/ current in Lower Cross are reflexes of \*/gʷ/, \*/b/, or \*/f/, but it does not seem possible, based on the data currently available, that it can also be reconstructed as a separate phoneme, occurring stem-initially. In Chapter Two, however, arguments were offered (following Cook 1969b) for analysing instances of [Cu] and [Ci] as underlyingly being /Cw/ and /Cj/. The line of reasoning presented there may also be plausibly applied to PLC, suggesting that the situation in the parent language was essentially quite similar to what obtains in most, if not all, of the present-day LC languages. On the other hand, it is worth speculating on the origin of these sequences, as the comparative data already presented in this chapter do have implications for this question. Cook (personal communication) has presented a line of argumentation which suggests that these sequences (at least in some cases) arose from original CVCVC structures, which followed a gradual pattern of reduction, such that the internal C eventually dropped out, leaving CVVC, which was reinterpreted *phonologically* as CGVC (‘G’ representing ‘glide’ or ‘approximant’).

From a diachronic point of view, then, the interesting question would be what stage these developments were at during the time of PLC, and whether there was ever a period when it would have been legitimate to speak, phonologically, of a vowel cluster, /CVVC/. A number of the examples presented here suggest that the earlier CVCVC

structure was still extant at the time of PLC, viz. \*mání ('flog', Table 4.2.3), \*òfiṇèm ('crocodile', Table 4.2.6), \*úbùkòt ('head', Table 4.2.7), \*útíkát ('stone', Table 4.2.8), and \*lùkòp ('ten', Table 4.2.10). Other possible examples, such as PLC \*úkuák 'metal', or \*ébúá 'dog', suggest that this is a long-running process, going back farther, into the prehistory of the Lower Cross languages - i.e., that the intervocalic consonant in these (assuming there was one) had already disappeared by the time of PLC. Certainly a detailed study of the evolution of the vowel systems of Lower Cross will shed some light on the question, but a more satisfying answer will only come from the reconstruction of yet earlier stages - Proto Delta Cross, Cross River, Benue-Congo, etc.

#### 4.5. Proto-Lower Cross consonants in ambisyllabic position

In addition to providing some speculation on certain vocalic developments in Lower Cross history, the preceding paragraphs have also given some insight into the development of ambisyllabic consonants in Lower Cross. As pointed out in Chapter Two, the distribution and phonetic realization of these consonants in Lower Cross synchronically are essentially the same across the group, suggesting that the most plausible situation to reconstruct for PLC is one that is not too far different from that which obtains today. Certainly the evidence for a postulating a wider range of permissible consonants in this position is scanty; based on what is available, the only other possible inclusion would be PLC \*/j/, as this is found in at least one of the languages today (Ibibio, e.g., 'sleep!' *dáyá* /*dájá*/).

It is also possible to argue that phonetic realizations were basically the same. However, this is done with some qualification. In reconstructing intervocalic consonants that have disappeared in at least some languages, but were present in PLC (as discussed in the preceding paragraphs), it is also possible that other (or perhaps all) ambisyllabic consonants were more strongly realized. It is worth considering, as well, variation that exists today with regard to ambisyllabic consonants (see §3.7) - for instance Uda 'bow' [útíkÉ] where others have a voiced realization of the ambisyllabic consonant /k/<sup>95</sup>.

---

<sup>95</sup> In some cases this variation may be more indicative of whether the consonant is indeed ambisyllabic, rather than what phonetic realizations ambisyllabic consonants have. This is an issue that will be explored at a later date.

#### 4.6. PLC consonants in final (pre-pausal) position

As with ambisyllabic consonants, it is a safe assumption that the distribution and realization of final consonants in PLC largely paralleled that which obtains in all of the present-day languages (see Chapter Two); that is, phonetically, only nasals and voiceless, unreleased stops were permissible. There are numerous examples in the foregoing Tables in this chapter that can be drawn as evidence for reconstructing these consonants: [p t k m n ŋ] (probably /b d k m n ŋ/ - see Chapter Two). Two questions may be posed regarding this aspect of the PLC sound system: 1) at what stage was the inventory of consonants reduced to that now found in the group (i.e., phonologically three places of articulation, oral and nasal), and 2) within these, at what period did an assumed earlier voiced/voiceless opposition disappear?

As to the first of these, there is no evidence synchronically in Lower Cross to suggest that a reduction in the number of places of articulation occurred in or since the PLC period. A comparison with permissible final consonants in the related Delta Cross groups (especially Upper Cross) suggests that there was, at an earlier stage (probably Proto Delta Cross), more variety. The answer to the second question is again pre-Lower Cross but perhaps closer to the PLC stage. This conclusion is based on the fact that, although this opposition is neutralized in all LC languages synchronically, at least for some words in some languages there is a tendency to have voiced stops finally (see §3.7.). It is plausible to suggest that this tendency reflects an earlier voiced/voiceless opposition.

Apart from these questions, there is one other aspect of final consonants in Lower Cross which bears discussion here, and that is their attrition. There is a tendency towards the loss of final consonants in the group which is clearly manifested more strongly in some languages than others. For the most part, these are the ones found in the south-east of the Lower Cross region: Ebughu, Efai, Ekit, Enwang, Etebi, Ilue, Okobo, Oro, Uda, and Usakade. Among these, there is some consistency as to consonant attrition, but also considerable variation; what can be said for all of them is that more than 50% of words examined (using the comparative lists) are without final consonants; Ekit and Usakade are typical, with 61% and 57% respectively, compared to 38% and 44% for Ibibio and Efik, respectively. In examining words where final consonants have been retained, it was possible to establish a hierarchy of preference for retention, both with regard to nasality, and to place of articulation. Nasals apparently survive longer, though there is no strong evidence of a merger of the oral/nasal

distinction prior to loss; in those languages where final consonants are being lost, again values for Ekit and Usakade can be considered typical of the range, 56% of finals in Ekit being nasals, and 74% in Usakade. These values may be compared to the virtually 50/50 split found in languages such as Ibibio and Efik. This question is returned to again, in Chapter 5.

#### **4.7. Implications for sub-grouping within Lower Cross**

Examination of sound correspondences is traditionally considered to be the most reliable means of classifying, or sub-grouping languages; it would therefore perhaps be remiss not to offer a few conclusions concerning this aspect of Lower Cross linguistics. This will be done by first looking at the most significant of these correspondences and by judging the others in the light of its implications. The most important correspondence is apparently that of /d/ - /l/ - /n/, where /d/ and /n/ were determined to be reflexes of \*/l/.

Postulating \*/l/ allows the establishment of a major sub-group within Lower Cross, consisting of Anaang, Efai, Efik, Ekit, Etebi, Ibibio, Ibuoro, ItuMbuso, and Ukwa. That the implied grouping is correct is supported by the fact that within this group there is a high degree of mutual intelligibility (especially among Anaang, Efik, and Ibibio), and generally higher cognacy rates than those that obtain for the rest of the group (see Appendix C). For primarily geographic reasons, this sub-group will be referred to as Central Lower Cross. Before going further, certain complicating factors merit examination. One of these is the existence of both /l/ and /d/ as apparent reflexes of \*/l/ in Ibino. It is considered here that the change to /d/, where it has occurred, is a recent development (i.e., a merger is in progress), and is the result of influence from neighbouring Ekit and prestigious Efik. A quantitative study of this variation would contribute important evidence to answering this question.

On the other hand, if /l/ is postulated as a reflex of \*/d/, a much more complex situation arises. This hypothesis would suggest that languages scattered across almost the entire geographical area of Lower Cross have shared a period of common development not enjoyed by those geographically contiguous languages which occupy the central region, and that this latter group has not undergone such a period of common development. As there is no independent evidence to substantiate such a hypothesis, it is rejected. Alternatively, we would be obliged to accept \*/d/ > /l/ as an



independent development in each (or most) of the languages in question, a rather unlikely scenario, given the evidence in favour of \*/l/ > /d/.

The next most significant consonantal development is perhaps that of PLC \*/k/, which has gone to /s/, /tʃ/, /dʒ/, or remained as /k/, depending on the language, before high front vowels. This development cuts across the subgrouping established above, without readily suggesting an alternative. (Ibino, Iko, Ilue, ItuMbuso, and Oro have retained \*/k/ in this environment.) It is possible that this process was already in progress at the time of the break-up of PLC; however, it will be noted that such a development is well attested in languages throughout the world, and has a transparent physiological basis. It is entirely appropriate, then, to suggest this as an independent development in the various languages affected.

While the same conclusion must apparently be reached regarding the developments of PLC \*/kp/, the situation is considerably more complex. Changes of \*/kp/ to /p/, /b/, /gb/, or /kʷ/ (or the retention of \*/kp/) again cut across the boundaries suggested above, but without offering a more attractive alternative. In Anaang, the change is in one dialect, and within that dialect, more or less complete. (I.e., \*/kp/ has apparently ceased to exist in this dialect; it is perhaps being re-introduced in the speech of some younger speakers through the influence of Efik, Ibibio, and other Anaang dialects.) In Ebughu, Enwang, and Okobo, the change is also complete; in Uda and Usakade \*/kp/ continues to exist alongside the present day reflexes, /p/ and /b/, respectively. These reflexes occur in different lexical items in the two languages, and so no connection between the two (i.e., no period of common development) is postulated. Finally, the development seen in Obolo must be accepted as an independent development in that language, as it involves a different reflex and a different set of lexical items. It may be possible to suggest a sub-group consisting of Ebughu, Enwang, and Okobo on this evidence which would not contradict the /d/ - /l/ - /n/ criterion; however, for reasons given below, it would seem desirable to include Uda as well. This inclusion is slightly problematic. A limited set of items in both Enwang and Uda demonstrate \*/b/ > /v/, which suggests a time of common development for these two, separate from the others. It seems contradictory that the \*/kp/ > /p/, which would have to have preceded \*/b/ > /v/ for the larger grouping to be valid, would not be complete in Uda.

For the present, then, the proposal that Ebughu, Enwang, Okobo, and Uda form a sub-group is rejected, in favour of a smaller group consisting of Enwang and Uda. Accepting this, the change of \*/kp/ > /p/ must be viewed as an areal phenomenon, resulting possibly from an inherent instability of PLC \*/kp/. The \*/b/ > /w/ change attested in many of the Lower Cross languages does not provide any substantial evidence of a sub-grouping, particularly as the lexical items affected vary from language to language. Rather, it appears to reflect a general tendency of consonant lenition in Lower Cross. Other attested changes serve only to reinforce the autonomy of individual languages, for example, \*/f/ > /w/ in Obolo, \*/b/ > /β/ in Usakade, and \*/b/ to /p/ in Ibino are changes confined only to those languages.

The comparative evidence, then, suggests only one strong subgroup within Lower Cross, which I have chosen to call Central Lower Cross. This consists of Anaang, Efai, Efik, Ekit, Etebi, Ibibio, Ibuoro, ItuMbuso, and Ukwá. The only other possibility is a minor group of Enwang and Uda. This leaves the rest of Lower Cross languages as independent off-shoots of the parent language. For both Obolo and Usakade this is obviously the case, as each is sufficiently different from the rest of the group. For the remaining languages, the characteristics they share (which are not inconsiderable) are all assumed to be retentions, inherited from Proto-Lower Cross. Further evidence could be adduced in favour of this conclusion, but as this evidence is essentially non-linguistic (e.g., oral traditions) it is left to be reported elsewhere (Connell and Maison, forthcoming).

#### 4.8. Summary

In summary, a reconstruction of the consonant system of Proto-Lower Cross has been proposed, primarily through consideration of root-initial occurrences, as no evidence has been found to suggest there were any consonant contrasts in the parent language which did not occur in this position. Certain of the reconstructed consonants were arrived at with a high degree of confidence; other aspects of the reconstruction, particularly the exclusion of \*/c/ and \*/g/, and to a lesser extent \*/gb/, may as a result of future work have to be reconsidered. Table 4.7a summarizes the main phonetic developments of the PLC consonant system into the present-day languages.

It has also been possible to reconstruct the phonetic realizations of the PLC consonant system to a large extent. For example, the nature of the reflexes of PLC \*/kp/ give strong indications as to what its phonetic nature must have been; in



particular, the same kind of variation revealed in the production of Ibibio /kp/ (§3.6), in all probability existed in PLC. Similarly, the diachronic stability of PLC \*/t/ indicates that this consonant very likely had the strong articulation found in Lower Cross today.

The reconstruction has also provided evidence for an internal classification of Lower Cross. One major sub-group has been established, Central Lower Cross, and a smaller one, Enwang-Uda suggested. It is believed the remaining languages are all independent off-shoots of the parent language. Discussion of the break-up of the parent group and speculation on migratory routes will be found in Connell and Maison (forthcoming).

An aspect of Lower Cross classification that has not been discussed is its integrity as a group; what shared innovations exist among the languages of the group that establish the group identity? Such innovations are rather elusive. The loss of an assumed pre-Lower Cross fortis/lenis distinction is one candidate, though further comparative work among the various Delta Cross groups will need to be done to definitely establish this. Another candidate is the shift from an earlier labial stop (presumably PDC \*/p/) which is realized regularly in Lower Cross as /f/, with the exception of Obolo where PLC \*/f/ has generally gone to /w/. The status of Obolo within Lower Cross has always been somewhat controversial among students of Lower Cross linguistics, for its differentiation relative to the rest of the group. Despite the wide gap that exists between Obolo and the rest of Lower Cross, there is evidence of sound correspondences and a number of apparent lexical innovations that link Obolo to Lower Cross. And in any case, the Lower Cross group without Obolo would still remain that language's closest relative - the result would be the addition of another node to the Cross River tree.

PLC	*m	*n	*ɲ	*b	*t	*d	*l	*j	*k	*kp	*g <sup>w</sup>	*f	*s
Anaang	m	n	ɲ <sup>w</sup> /w̃	b/w	t	r/d	d	j/d3/dz/ɟ	k/s	kp/p	g <sup>w</sup> /w	f	s/tf
Ebughu	m	n	ɲ <sup>w</sup> /w̃	b/β	t/ɸ	r/d	l	j/d3/ɟ	k/s	p	g <sup>w</sup> /gb	f	s/z
Efai	m	n	ɲ <sup>w</sup> /w̃	b	t	d	d	j	k/s	kp	g <sup>w</sup> /w	f	s
Efik	m	n	ɲ <sup>w</sup> /w̃	b	t	d/r	d	j	k/s/t	kp	w	f	s
Ekit	m	n	ɲ <sup>w</sup>	b	t	d	d	j/d3	k/s	kp	g <sup>w</sup> /g	f	s
Enwang	m	n	ɲ <sup>w</sup>	b/v	t	d/r	l	j	k/s	p	w	f	s
Etebi	m	n	ɲ <sup>w</sup> /w̃	b	t	d	d	j/d3/dz	k/s	kp	w	f	s
Ibibio	m	n	ɲ <sup>w</sup> /w̃	b/w	t	d/r	d	j	k/s	kp	w	f	s
Ibino	m	n	ɲ <sup>w</sup> /w̃	p/b	t	d/r	l/d	ɸ	k/ɸ	kp	k <sup>w</sup> /w	f	s
Ibuoro	m	n	ɲ <sup>w</sup> /w̃	b	t	r/d	d	j	k/s	kp	w/g <sup>w</sup>	f	s
Iko	m	n	ɲ <sup>w</sup> /w̃	b	t	r/d	l	j	k/ɸ	kp	g <sup>w</sup>	f	s
Ilue	m	n	ɲ <sup>w</sup> /w̃	b	t	d	l	j	k	kp	g <sup>w</sup> /w	f	s
ItuMbuso	m	n	ɲ <sup>w</sup> /w̃	b	t	d	d	j	k/ɸ	kp/p	w	w	s
Obolo	m	n	ɲ <sup>w</sup> /w̃	b/f	t/ɸ	r/d/d3	l/r	d3/j	k/g/ɸ	kp/k <sup>w</sup> /gb	g <sup>w</sup> /g/w	w	s/dʒ
Okobo	m	n	ɲ <sup>w</sup> /w̃	b	t	d/r	l	j	k/ɸ	p	w	f	s
Oro	m	n	ɲ <sup>w</sup> /w̃	b/f	t	d	l	j/d3/dz	k	kp	w/g <sup>w</sup>	f/w	s/z
Uda	m	n	ɲ <sup>w</sup> /w̃	b/v	t	r/d	l	j/d3/dz	k	p/kp	g <sup>w</sup> /w	f	s
Ukwa	m	n	ɲ <sup>w</sup> /w̃	b	t	d	d	j	k/s	kp	w	f	s
Usakade	m	n	ɲ <sup>w</sup> /w̃	β/b	t/ɸ	d/r	n	j/d3	k/ɸ	b/kp	w	f	s

Table 4.7a: Consonant correspondences among the Lower Cross languages

## Chapter Five

### The Phonetic Basis of Consonantal Developments in Lower Cross

#### 5.1. Introduction

This chapter presents an understanding of consonantal sound change in the Lower Cross languages on the basis of their phonetic characteristics<sup>96</sup>. Justification for such an approach was offered in Chapter One; the phonetic data needed for the discussion came in Chapter Three, and evidence for the existence of particular changes was presented in Chapter Four. Therefore, whereas each of those chapters could be seen as constituting works capable of standing on their own, this fifth chapter stands on the foundation provided by the preceding ones. Implications of the Lower Cross developments for a theory of sound change are central to the discussion.

In Chapter One, a theory of sound change based on the concepts of signal detection theory was introduced. In brief, this theory of sound change looks at the various stages of the speech transmission process, predicting that the speech signal may be perturbed, for different reasons, at each stage. It is these perturbations that may lead to sound change, which may therefore be seen to have different motivating, or mediating, factors. For Ohala, who has perhaps done the most to develop this view of sound change, it would appear that perceptual factors play the greatest role in precipitating change (see Ohala 1981, 1989); indeed, sound change is deemed not to

---

96 Some of the material in this chapter originally appeared in Connell (1987c) and Connell (1989).

have occurred until there has been a change in perception<sup>97</sup>. This view (the importance placed on the role of the listener) was examined in Chapter One, and though not rejected, I here provide evidence that underlying many, if not all, sound changes that appear to be the result of perceptual confusions (misapprehensions) are articulatory considerations. These articulatory factors need to be taken into account in order to have a more complete understanding of sound change. The Lower Cross evidence leads to consideration of what might be viewed as a competing theory of sound change, the theory of Articulatory Evolution, developed by W. Pagliuca and his colleague R. Mowrey (Pagliuca and Mowrey 1980, Pagliuca 1982, Pagliuca and Mowrey 1987). This theory is briefly sketched in the following paragraphs<sup>98</sup>.

As also discussed in Chapter 1, there has long been controversy as to whether sound change should be viewed as being phonetically abrupt, or phonetically gradual; the latter was the view held by the Neogrammarians, while the former is the position espoused by scholars such as Wang (1969) and Ohala (personal communication), and is also inherent in the generative approach to sound change. Labov (1981) gives evidence for phonetically gradual change in vowel systems, and Pagliuca and Mowrey (Pagliuca 1982, Pagliuca and Mowrey 1987) argue that this is also the case for consonantal change, but without providing any direct instrumental evidence to buttress their claims. The question of graduality, therefore, bears directly on the evaluation of the two competing theories. The evidence presented in this chapter supports the argument that the existence of phonetically gradual change must also be recognized for consonants as well.

#### 5.1.1. Articulatory Evolution

Traditionally, sound change (at least consonantal change) has been regarded as being the result of processes of assimilation, lenition (weakening, softening) or fortition (strengthening, hardening). This view has been criticized in particular by Pagliuca and Mowrey, who argue that "these terms carry unwanted connotations peculiar to other theories of sound change" (1987: 460) - i.e., segmentally oriented views of sound change which, in effect, do no more than present 'before and after'

---

97 The view presented in Ohala (1981, 1989) seems to incline more to a perceptual view of change than that found in his earlier work, e.g., Ohala (1974a).

98 Pagliuca and Mowrey (1980, 1987) explicitly deny the relevance of perceptual factors with regard to internal change, precisely the type of change under discussion in this work; i.e., change which does not arise through contact or other socially attributable factors. It is this position which leads me to describe (at least initially), the two theories of sound change as 'competing', and certainly they consider it to be a competing theory.

scenarios, and thereby miss capturing the phonetic content essential for an adequate understanding of sound change. For them, what has usually been referred to as lenition can more appropriately be seen as the 'substantive reduction' of an articulation (i.e., in degree of contact or constriction), and assimilation is considered to be 'temporal reduction' (i.e., the temporal compression of adjacent articulations). These two reductive processes are a result of a decrease in muscular activation, which is claimed to occur gradually over a considerable period of time, and is related to the frequency of occurrence of an articulatory gesture (Pagliuca 1982). Sound change - articulatory evolution - therefore, is a direct result of neuromuscular events, a reduction in the activity of a given muscle. Alphabetic notations, and the theories that they represent, not only fail to capture, but obscure this fact.

Recognition of the processes of substantive reduction and temporal reduction as being the major participants in sound change leads to the view that change is evolutionary, and suggests that "no new articulatory gestures are introduced through evolutionary phonetic processes" (1987: 467) - what Pagliuca and Mowrey refer to as the Principle of Differential Retention (PDR). This brings them to argue that those changes typically seen as fortitions should be re-examined; that many of these are actually cases of substantive reduction (e.g., a change of stop to affricate<sup>99</sup>), while others are a result of language contact rather than internal change. It is suggested that any remaining changes traditionally seen as fortitions may well be the result of flawed reconstruction.

Pagliuca and Mowrey offer some enlightening insights into the nature of sound change, particularly in distinguishing substantive reduction and temporal reduction as two distinct evolutionary processes. They are correct in suggesting that it may be difficult to isolate the two processes, one from the other, but at least one of the developments in Lower Cross examined below indicates that the two are separable, and not always co-present, as they surmise. That is, while both processes must play a role in the evolution of an articulation, they may not necessarily both be active concurrently.

#### 5.1.2. Contributions from Lower Cross

In the developments found among the Lower Cross languages, we find some support for the theory of Articulatory Evolution, particularly regarding the recognition

---

<sup>99</sup> Such a change has often been seen as fortition, but when viewed from the point of view of articulation can be seen as resulting from a reductive process, as it results from a slowing down of the release.

of two types of reduction. The Principle of Differential Retention suggests a different reconstruction for Proto-Lower Cross regarding its oral palatal consonant than was first proposed in Connell 1987b, i.e., PLC \*j, rather than \*ɟ. This reconstruction also appears to be independently motivated, however other LC developments suggest that the PDR needs to be reformulated. The question still arises though, as to whether the theory of Articulation Evolution can account for all types of sound change (in the restricted sense used here), or whether it should or could in some way be amalgamated with other theories<sup>100</sup>.

Various aspects of the nature of sound change are therefore identified and discussed in this chapter: whether sound change is principally a perceptual or a productive phenomenon<sup>101</sup>, whether sound change is abrupt or gradual from a phonetic standpoint, and the extent to which the concepts of weakening and strengthening are adequate in discussing sound change. A fourth and perhaps more general question, which has haunted historical linguistics since the outset of diachronic studies, is the actuation problem: why, under seemingly similar circumstances, a sound will develop differently in different languages or dialects. The data presented in Chapters 3 and 4 gave evidence of a number of consonantal changes having occurred in the Lower Cross group in the course of its differentiation that might shed light on these issues; while four of these developments (or, sets of developments) would suffice to support the claims to be made, other changes are also discussed. Those that receive the greatest attention are the developments of PLC \*d, the palatals \*ɟ and \*ɲ, \*gʷ, and \*kp.

The evolution of PLC \*kp to [p], [b], or [kʷ] (in those languages where it has changed) is interesting, as it is the kind of change which, in all likelihood, would be ascribed to perceptual confusion or misapprehension; the phonetic analysis of this consonant in Ibibio presented in §3.6 certainly agrees with such reasoning. But it also suggests that articulatory variation underlies not only the possibility for confusion at the perceptual level, but also accounts for the variety of reflexes which obtain across the group (thereby suggesting an answer to the puzzle of differential development). Other evidence regarding the production of Ibibio [kp] suggests that not only is the articulatory variation discussed in §3.6 critical in understanding the evolution of this

---

100 The position adopted in Pagliuca and Mowrey (1987) is somewhat stronger (though less elaborated) than that presented in Pagliuca (1982), where the possibility of non-physically based change (i.e., perceptually or psychologically - based) is admitted, but these are considered to be non-evolutionary.

101 This is not to suggest that only one aspect or the other is involved; Ohala's model presented in Chapter One makes this clear, despite his leaning to the perceptual side.



consonant, but as well, the velar articulation seems to gradually erode, rather than disappearing at once.

Similarly, it can be argued from the evidence of electropalatography, that the change from PLC \*d to [r] can be seen as occurring gradually, as the degree of contact involved in the production of Ibibio [d] appears to be reducing, towards that involved in the production of [r]. This development supports the distinction drawn between substantive reduction and temporal reduction, in that the contact duration for [r] is only marginally less than that for [d]. Apart from this, the asymmetrical contact pattern found for [r] is instructive in understanding why this sound and [l] are frequently found to be reflexes one of the other, or why in many languages the two often appear as allophones in free variation.

The developments of PLC palatals, and of \*g<sup>w</sup>, also based on evidence from EPG, all represent instances of substantive reduction, again lending support to the assertion that consonantal change can indeed be phonetically gradual.

One other set of developments occurring in the group, which may be better understood when viewed from a phonetic perspective, involves changes in phonation, particularly, the 'sporadic' voicing manifested in certain of the languages, and the devoicing found in Ibino. These changes are examined, and finally a brief discussion is given of developments in ambisyllabic and final consonants.

## **5.2. Gradual change and developments in the PLC consonant system.**

The question of whether sound change is phonetically abrupt or gradual has been one of the long standing controversies in historical linguistics and, as mentioned above, much current thinking falls on the side of abruptness from the phonetic standpoint, while accepting that sound change (or more properly, its propagation) is lexically gradual (see, e.g., Wang 1969). The developments of PLC \*d, \*j, \*ɲ, and \*g<sup>w</sup>, shed interesting light on not only this issue, but also on the question of how sound change should be viewed generally.

### **5.2.1. PLC \*d and Ibibio alveolars**

PLC \*d developed to [d], [r], [ɹ], and [l] variously in the group, as discussed in Chapter 4. This history is summarized in Figure 5.2a, which shows the evolution of PLC \*t, \*d, and \*l across the group (i.e., developments in the various languages have been collapsed in this figure). When viewed from the perspective of the articulatory

nature of Ibibio alveolars [t], [d], [r], these developments lend support not only to the notion that consonantal change is indeed gradual but also to the general view that detailed articulatory evidence should be taken into consideration when examining sound change.

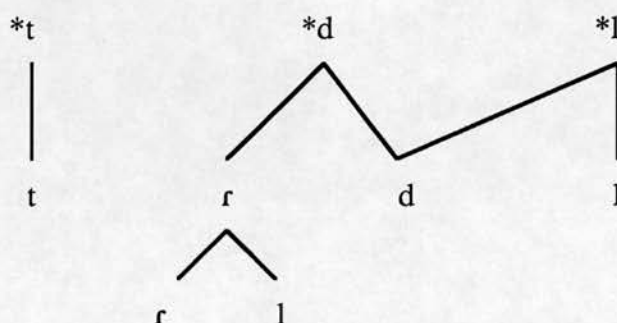


Figure 5.2a: Development of PLC alveolars

As background to the discussion, phonological characteristics concerning the distribution and realization of consonants in Ibibio need to be borne in mind. These were presented in Chapter Two, but may be summarized here, with regard to the alveolars, simply by recalling that in initial position, both [t] and [d] occur, while in ambisyllabic position, [r] and [ɾ] occur (both may be analyzed as allophones of /d/). As pointed out in Chapter Three, for some Ibibio speakers, as elsewhere in Lower Cross, [r] may also occur initially, in at least some words, and in apparent free variation with [d]. The Ibibio speaker used in the EPG work discussed below did not exhibit this variation in initial position, but had (auditorily) only [d].

The electropalatographic investigation reported in §3.4 revealed some considerable differences between the articulation of [t] and [d]; these differences are explored in greater depth here. Figure 5.2b presents EPG charts for [t], as excised from the word àtààd [àtà:t-], ‘wasp’ (i.e., the initial [t]), showing the consonant to be denti-post-alveolar. As the charts show, in four repetitions of this word the contact pattern, and presumably the entire gesture, varied hardly at all, in terms of both movement and area of contact, and duration of closure.

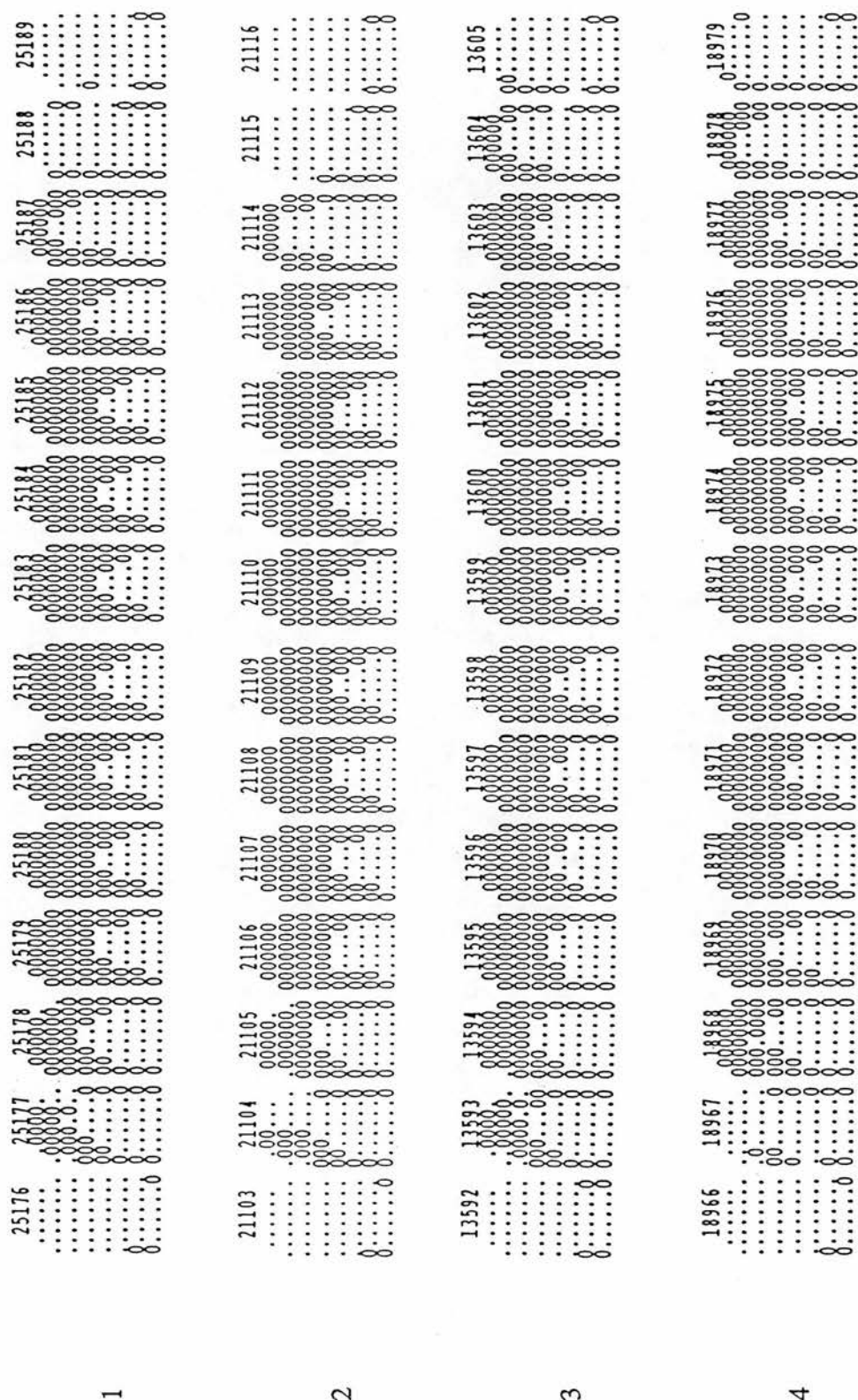


Figure 5.2b: EPG charts for four repetitions of Ibibio /t/ ([t]), as excised from àtàd [àtāt], 'wasp'. Each frame represents 10 ms. (Speaker: B. Etuk.)



Figure 5.2c: Four tokens of /d/ ([d]), excised the word àdàghá [àdàũǎ] 'underneath'. Each frame represents 10 ms. (Speaker: B. Etuk.)

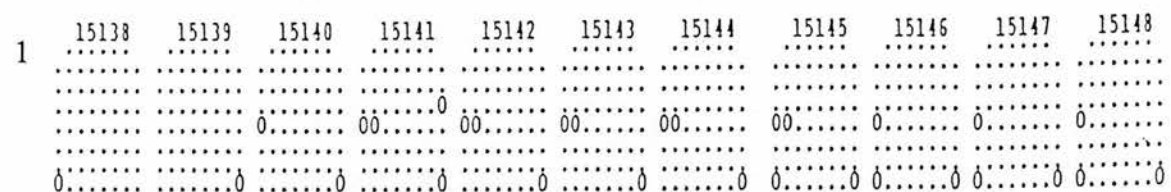
In contrast to this, Figure 5.2c shows EPG charts for [d]; four tokens are presented, each excised from a repetition of the word àdàghá [àdàwá] 'underneath'. What is striking, first, are the differences in articulatory gesture for this consonant and that for [t]. These differences exist primarily with regard to duration of closure and location and total area of contact.

Of greater importance, though, is the variation noticeable in the different tokens of [d]. In comparing the 4 tokens, differences can be seen first in duration of contact: in repetition 1, complete closure is achieved for only 10 ms, but 30 ms, 50 ms, and 40ms for repetitions 2, 3, and 4, respectively. With regard to degree of contact, repetition 3 shows a greater area of linguo-palatal contact, while repetition 1 has only a weak closure at best; it is noteworthy that when the closure is weak or incomplete (e.g., repetitions 1 and 2), it is in the center of the contact area where the contact fails. Concerning location of contact, repetition 1 is more retracted, showing contact primarily in rows 4 and 5, while the others show contact mainly in rows 3 and 4. In time needed for achievement of complete closure, there is also variation: 50 ms for repetition 1, 30 ms for 2, and 20 ms each for repetitions 3 and 4. Finally, there is some variation as to the duration of the complete articulatory gesture across the four repetitions.

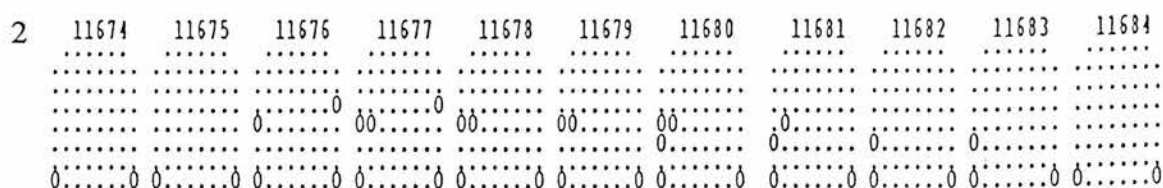
The tokens of [t] and [d] illustrated are excised from a [a\_a] vowel environment; examination of these consonants in other vocalic environments (cf. §3.4) revealed to an even greater extent their differences (and, important for the present discussion, the relative stability of [t]). Both are subject to coarticulatory effects; however, the amount of variability is again much greater for [d] than [t]. These differences suggest, first, that [d] is a weaker consonant than [t]. Second, the variation seen across tokens of [d] itself indicate not only that this is a weaker articulation, but that it is apparently an unstable articulation. These conclusions, together with observations concerning the articulation of [r], presented below, and the evolution of alveolars in other Lower Cross languages (see Chap. 4), suggest that Ibibio [d] is in a period of incipient change.

I turn now to the realization of [r] in ambisyllabic position. Here, there is occasionally some difficulty in deciding, auditorily, whether a given articulation should be characterized as a tap or an approximant (more on this below; cf. also §3.7.4).

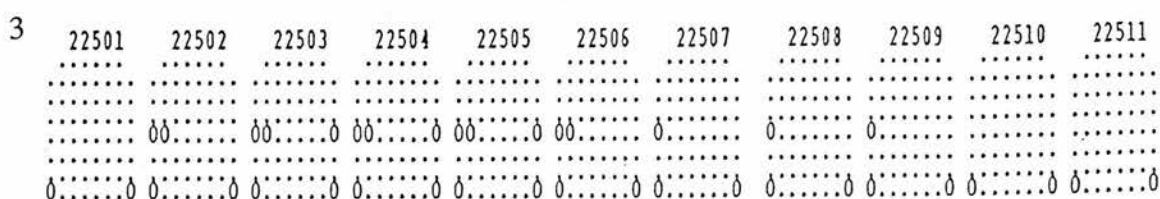




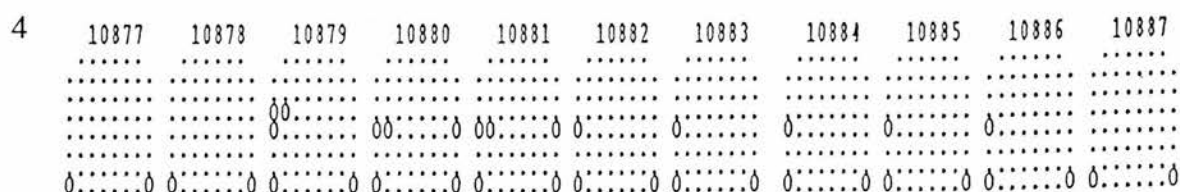
[r] ~ [ɹ]



[r]



[r] ~ [ɹ]



[r]

Figure 5.2d: Four repetitions of ambisyllabic /d/, from /àkpàdà/ [àkpàrà] 'prostitute'. Charts with alternative transcriptions ([r] ~ [ɹ]) represent utterances where there was difficulty in deciding which sound was heard. Each frame represents 10 ms. (Speaker: B. Etuk.)



Figure 5.2d presents EPG charts for four repetitions of the ambisyllabic portion of the word àkpàrà [àkpàrà] 'prostitute' (i.e., the [r]). The transcription given under each chart indicates whether the articulation for that repetition was heard as [r], or was irresolvable between [r] and [ɹ].

In comparing this articulation to that of [d], the most noticeable difference is in degree of contact, with [r] having contact only at the sides, not in the center, and with this contact normally being stronger on one side than the other (though still weak). This latter observation applies to both degree and duration of contact. It is important to recall here that for [d], when the contact was weak or incomplete, it was also the center area of contact which was affected - see Fig. 5.2c. In addition to this, the articulation is retracted relative to [d], with contact mainly in row 5, i.e., the post-alveolar region. Apart from these characteristics, [r] and [d] are of comparable overall duration, though [r] may be slightly shorter<sup>102</sup>.

### 5.2.2. Perceptual Interlude

For two reasons, it was decided to conduct an informal perceptual test. The first of these was simply to see if trained phoneticians could detect the kind of variation found in the articulation of [d]. The second reason was the difficulty experienced in transcribing certain instances of ambisyllabic [r] which, as mentioned above, was more than merely deciding whether a given token should be labelled [r] or [ɹ]. In fact, for many of these (as indicated in the transcriptions accompanying Fig 5.2d), the impression was one of hearing both of these sounds simultaneously. Therefore, it was decided to elicit the judgements of a number of trained phoneticians on a number of tokens of both [d] and [r], i.e., initial /d/ and ambisyllabic /d/, with the assumption that the results might shed some light on the relation between perception and sound change.

To do this, a set of 48 words containing tokens of [d] and [r] were selected from the audio recordings done simultaneously with the EPG investigation, and collated on a separate audio tape. This tape was then given to three trained phoneticians in the Dept. of Linguistics at Edinburgh, who were asked to transcribe the utterances at their leisure<sup>103</sup>. The instructions given were as follows:

<sup>102</sup> On examining Fig. 5.2d, it might at first be assumed that [r] is of longer duration (see e.g., rep.1), but it is possible that this lingering single electrode contact is due to saliva between the tongue and the artificial palate.

<sup>103</sup> My thanks to Gerry Docherty, Jody Higgs, and Alan Kemp for their participation.

There are 48 words on this tape to be transcribed. You are free to listen to each as often as desired, but if you change your transcription from your first impression, please indicate this. Also, if certain sounds are 'ambiguous', please indicate the different possibilities. I am interested mainly in your judgements of the consonants, but feel free to do the vowels narrowly as well. The language is Ibibio, which has two basic tones, high and low.

Consonants other than those of immediate interest, as well as words which did not contain either of [d] or [r], were included as 'distractors'. Altogether there were 30 tokens of initial /d/ and 21 tokens of ambisyllabic /d/. The list of words used for this experiment are found in Appendix C.

On the whole, the variation observed in the articulation of [d] in the EPG record was found not to be not perceivable by the participants. In approximately 10% of [d] tokens, a different response was given, usually [r], though in one case each, [l] and [n] were given, and also in one case, [m]. It was indicated in the previous section that there is some difficulty in distinguishing between [r] and [ɹ]. This held true also for the participants in the perceptual experiment. For them, a majority of potential [r] tokens were identified as such, but with a substantial number of [ɹ] and a small number of [l] responses also being given. On the other hand, a number of ambisyllabic tokens of /d/ were heard as [d] by the participants; these were invariably found preceding a word boundary, though still the majority of tokens of /d/ in this environment were identified as [r]<sup>104</sup>.

It may be argued that the results of such an experiment are uninformative, in that the subjects were not native speakers of Ibibio, nor did their language bear much similarity to Ibibio. The purpose, however, was to test whether the variation in evidence in the EPG record was detectable by trained phoneticians (presumably therefore, the issue of native language should not even arise). If not, then it should be a safe assumption that untrained native speakers, who also have the barrier of their own phonological filter to overcome, would also be unable to detect this type of minute variation.

It is apparent, then, that the kind of articulatory variation noticed for [d] is essentially imperceptible, even to trained phoneticians, and may be taken as lending some support to the Neogrammarian notion of sound change being imperceptible, if the

---

<sup>104</sup> This phenomenon is of interest for other reasons, but is outside the scope of the present work. It is worth pointing out, however, that in these cases articulatory patterns were similar to those found for initial /d/, rather than ambisyllabic /d/.

arguments presented in the following section are accepted. On the other hand, variation in responses given for potential tokens of [r] is of interest in pointing to a possible role for perception in the development of a sound change, in this case with particular regard to a change from [r] to [l], which is in all probability related to the asymmetry in articulatory gesture noted above. This is discussed below, in §5.2.4.

### 5.2.3. Gradual change in Ibibio?

The instability of Ibibio [d], both inherent and relative to the stability of [t], has been illustrated by means of electropalatography. The articulation of this consonant was also compared to that of [r], and it was shown that the primary difference between the two is the lesser degree of contact for the latter. In other words, [r] may be seen as the result of a lessening or erosion of the gesture for [d], particularly in view of the fact that in both cases it is the center region of the contact area where contact is either reduced or non-existent. That is, the variation in evidence does not appear to be 'random' variation of the type one may have in mind in making statements such as 'no two utterances are identical', but rather, appears to be 'headed' in a particular direction<sup>105</sup>. We may therefore see the articulation of [d] as being in a state of incipient change, a change that is phonetically gradual and, at least at this stage in its evolution, imperceptible.

If this reasoning is acceptable, we then have additional evidence for a change-in-progress to buttress the desired geographical and generational evidence referred to earlier, in §3.6. Barring evidence to the contrary, the situation in Ibibio, and perhaps throughout Lower Cross, would appear to be one where a change from [d] to [r] is both phonetically and lexically gradual, i.e., the (to my knowledge) unattested possibility (4) of Wang (1969), referred to earlier, in §1.6.

### 5.2.4. The [r] to [l] development in Anaang

In Anaang, the change of PLC \*d to [r] is essentially complete - that is in the Abak dialect, which is often taken to be Anaang 'proper'. In the Ikot Ekpene area, [d] has been retained to a much greater extent, while in Ukanafun, and particularly in the more remote areas, a subsequent development of [r] to [l] has occurred. The EPG data also shed light on how this development might have been mediated in Ukanafun Anaang. For our Ibibio speaker, it will be recalled that a lateral asymmetry in the

---

<sup>105</sup> In saying this, I am not attributing any sort of teleology to the phenomenon, nor suggesting that all variation should be considered to be change. The importance of variation with regard to sound change is returned to below.

articulatory gesture was observed, i.e., with a preference for greater closure on one side and a more open approximation on the other (see, e.g., Fig. 5.2d). These articulations were at times heard (in the perceptual experiment described above) as being laterals. If we can assume the same kind of articulatory asymmetry developed at an earlier stage in Ukanafun Anaang, it becomes apparent how a particular set of articulatory conditions can give rise to a perceptual ambiguity of the kind often cited in connection with sound change. This is especially interesting in view of the frequency of occurrence of this phenomenon, either as an historical development or in languages such as Japanese, where the two (as well as [ɹ] and other variants) occur in free variation<sup>106</sup>.

#### 5.2.5. The merger of PLC \*d and \*l

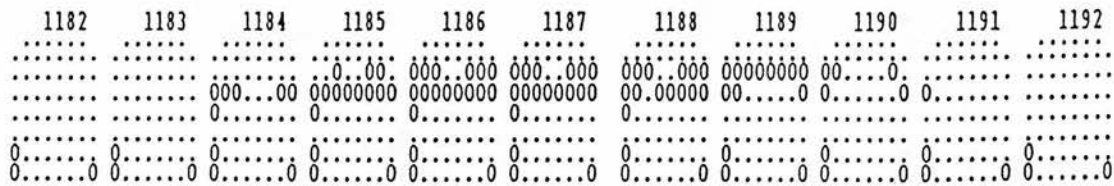
The foregoing developments can be seen from the perspective of the reductive processes postulated in the theory of Articulatory Evolution. The merger of PLC \*d and \*l, however, may at first appear problematic, as a change from [l] to [d] (where it has occurred) has typically been considered a fortition (i.e., approximant to stop). This need not necessarily be the case, however. It is entirely conceivable that a lateral articulation could involve a greater degree of contact than the cognate stop articulation, especially given the small contact area involved in the production of Ibibio [d]. Evidence for this is shown in Fig. 5.2e, where palatograms of English [l] reveal greater contact than found for Ibibio [d], and it would seem possible that such a situation could also arise within the same language. A change from [l] to [d], then, could conceivably involve a lessening in linguo-palatal contact, although at the same time involving a rearrangement of the contact configuration allowing for a central routing of the airflow.

#### 5.2.6. Development of PLC palatals

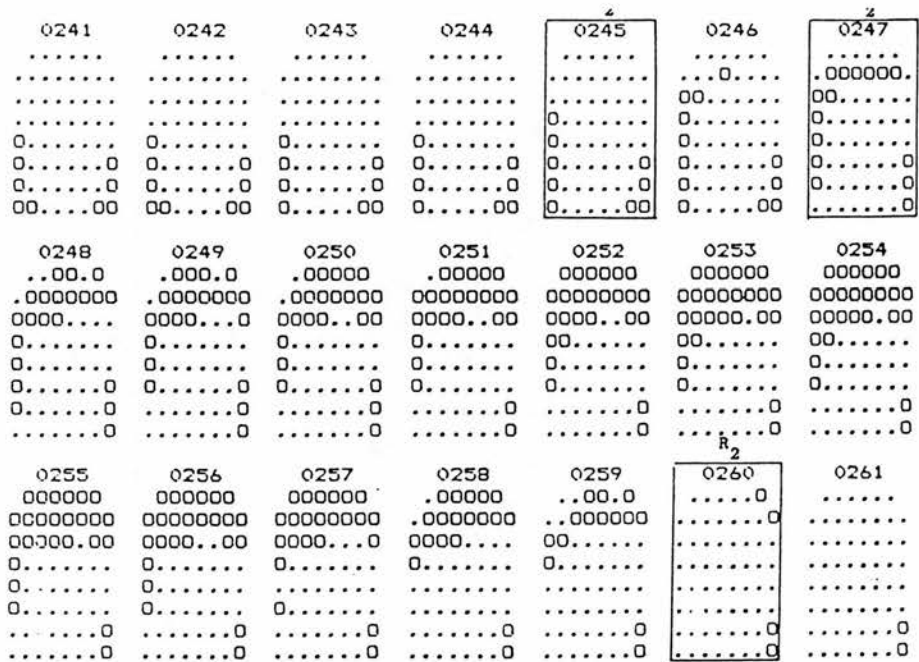
Problems in reconstructing the phonetic nature of the palatal consonants that existed in PLC were discussed in the preceding chapter. For both the oral and nasal consonants, a situation exists where synchronically there are both 'weak' and 'strong' realizations - i.e., approximants or fricatives as opposed to stops or affricates - and it was difficult to determine whether (in traditional terminology) a process of lenition or fortition was needed to account for the diachronic developments. For the nasal, a reconstruction (i.e., \*ɲ) suggesting a process of lenition - which we can now see as substantive reduction - was arrived at, to account for the widespread reflex [j].

---

<sup>106</sup> E.T. Uldall (1974) gives an interesting and useful review of descriptions of Japanese 'r' with regard to 'free variation'.



[d] Ibibio, from the context [ada]



[l] English, from the context [kla]

Figure 5.2e: Comparison of contact patterns for [d] (Ibibio) and [l] (English; from Hardcastle 1985: 251 ) The interval for the Ibibio charts is 10 ms; for the English, 7.5 ms. Boxes on frames 0245, 0247, and 0260 are from the original.



In §3.4., EPG evidence was presented to show that for my Ibibio speaker - who impressionistically has (by and large) [ɲ], there is, in some utterances, a substantial amount of reduction in the degree of linguo-palatal contact. A development from [ɲ] to [j] seems to be gradually occurring, and seen from the perspective of EPG, this development provides support for Pagliuca and Mowrey's theory.

Similarly for the oral consonant, it was concluded that a process of substantive reduction, affecting the different languages to varying degrees, has resulted in reflexes of [dʒ], [dʒ], [tʃ], [z], [j̥], or [j], depending on language / dialect (or idiolect?), from PLC \*ɟ (whether the devoicing which led to Ibino [tʃ] can be considered a reduction process is discussed below). EPG investigation that would provide the same support for this development as for developments of PLC \*ɲ and \*gʷ (see below) was not conducted; however, impressionistic evidence, i.e., variation between [j̥], [dʒ], [dʒ], [j̥], and [j], depending on speech style, as well as cross linguistic variation, suggests that this, too, has been a gradual erosion of an articulation.

#### 5.2.7. The erosion of PLC \*gʷ

Developments of PLC \*gʷ also support the view that consonantal change occurs gradually. In Chapter 3 (§3.6), the synchronic variation in evidence for this sound was described; that is, in some LC languages /gʷ/ (= [gʷ]) has been retained, while in others PLC \*gʷ has evolved to /w/ - with the degree of constriction at the velar place of articulation varying audibly, such that on occasion [gʷ] maybe realized, or [ḡw], or [w]<sup>107</sup>. This variation in velar constriction occurs across those LC languages where *phonologically* one would analyse the change as being complete. Ibibio is one of these, and one where, impressionistically, the velar articulation seems perhaps most eroded. The EPG analysis discussed in §3.4, however revealed that even for Ibibio there may still be substantial velar closure. The EPG charts presented in Fig. 5.2f, which represent 4 tokens of /w/ excised from repetitions of the word àsàwí (a type of lizard), illustrate the variation that may accompany the gradual erosion of an articulatory gesture.

This evidence, then, provides further support for seeing consonantal sound change as being gradual, and for analysing it from the perspective of Articulatory

107 The inadequacy of a segmental or alphabetic notation, which can only express stages or states, becomes especially evident in a situation such as this, in particular in that it obfuscates the graduality of the process underway. Cf. Pagliuca and Mowrey (1987: 462).



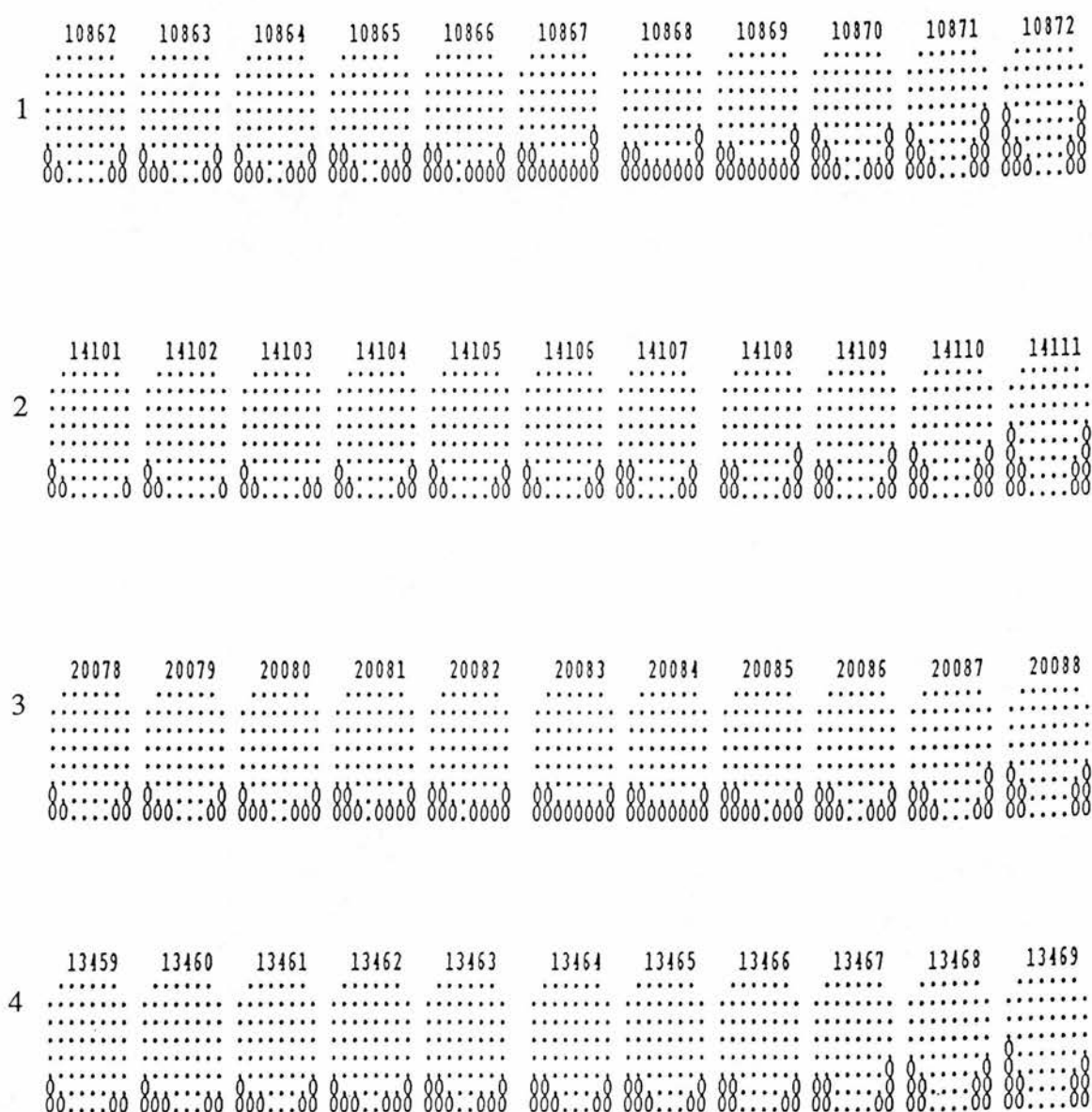


Figure 5.2f: Four tokens of Ibibio /w/ ([w] ~ [ʷ]), excised from repetitions of the word àsàwí (a type of lizard). Each frame represents 10 ms. (Speaker: B. Etuk.)

Evolution - the velar constriction associated with earlier [g<sup>w</sup>] has, in Ibibio, undergone (perhaps better, is still undergoing) a process of substantive reduction. That this is now perceived most often as [w], and analysed phonologically as /w/, is only part of the story, as clearly there is a residue of the earlier, more substantial articulation, which reflects its history.

There is one development of PLC \*g<sup>w</sup>, however, which is worrisome for Pagliuca and Mowrey's theory. In Ebughu, PLC \*g<sup>w</sup> has, in some words, gone to [gb] (see Table 4.2m), yet there is no evidence at all to suggest that this is a result of contact phenomena, or that the reconstruction needs to be re-evaluated; nor can this development be re-analysed as resulting from substantive or temporal reduction. The Principle of Differential Retention, which bars fortitions, is thereby called into question, as this is a clear case of fortition. However, the PDR bars fortitions on the grounds that no new articulations may be introduced into a daughter language, and despite the fact that PLC \*g<sup>w</sup> > Ebughu [gb] may be considered a fortition, it is also true that no new articulatory gestures have appeared in Ebughu - PLC had both [b] and [kp] ([kp] ~ [kɸ]), and either (or both) of these could have provided the 'model' for Ebughu [gb]<sup>108</sup>. The PDR can therefore be maintained, but it needs to be recognized that fortitions do not necessarily introduce new articulatory gestures into a language. In other words, if it can be shown that such developments also occur gradually, articulatory evolution need not be seen exclusively as a process of erosion.

#### 5.2.8. Other instances of substantive reduction

The developments described in the preceding paragraphs provide good evidence for the notion of substantive reduction, that it proceeds in a gradual manner, and that it may still be in operation after a given sound change appears to be completed. Among the Lower Cross languages there are other consonantal changes which can be viewed from this perspective. Most obvious of these are developments which have affected PLC \*b. We have seen that this has evolved, for example, to [w] in Anaang and dialectally in Ibibio, to [v] in Enwang and Uda. In all of these, the change has been 'sporadic' and has occurred only in intervocalic (but initial - cf. Chapter Two) position; as pointed out earlier, a preceding nasal has had a stabilizing influence.

---

<sup>108</sup> I am not suggesting that the development occurred through analogy - only that the relevant articulation existed already in PLC. It is not clear, though, that this would not constitute a new articulation from Pagliuca and Mowrey's point of view.

Apart from this, only in Usakade does the change (PLC \*b to [β]) appear to have run its course, and to be unconditioned (i.e. with regard to vowel environment). Most instances of \*b > [w] in Anaang or Ibibio appear to also have had following back rounded vowels as a conditioning environment, e.g., [íwòt-], [íwù:t-], 'head' (Anaang, Ibibio, respectively). Occasionally one finds, at least in Anaang, [β] when followed by high front unrounded vowels. In fact, both [w] and [β] have been found in this environment, e.g., [áβíðŋ] ~ [áwíðŋ] (from different speakers), suggesting that the [w] articulation is becoming generalized - spreading from its original conditioned environment. Indications that this process is a gradually developing one from the perspective of substantive reduction come from spectrograms of tokens of Ibibio [b], where what is auditorily [b] is revealed to have only a partial closure, while other tokens do appear to show a complete closure. The spectrograms in Fig. 5.2g may be compared, where 5.2g (a) is representative of a complete closure, 5.2g (b) indicates an incomplete closure (coming from the same speaker). It appears, then, that this articulation can be described as having an element of inherent instability similar to that discussed earlier for Ibibio [d]. Fig. 5.2g (c) and (d) are of Usakade /b/ ([b]) and /β/ ([β]).

Further support for the argument here, that this development is both articulatory and gradual in nature, is gained by looking at those instances where the articulation has not changed. It was seen in §3.6 that in Usakade PLC \*b was retained as [b] when preceded by [m]; this is also the case in other languages where PLC \*b has undergone some form of reduction. Apparently, then, the longer (or additional) labial occlusion ([mb] as opposed to [b]) has had a stabilizing influence on the simple labial consonant (cf. Ohala 1980).

Finally, it is worth noting that although this evidence indicates substantive reduction, it also suggests temporal reduction need not be involved, as the durations of Ibibio [b], and Usakade [β] are similar (100 ms and 103 ms, respectively), whereas for Ibibio [β], the duration is reduced (47 ms), and is best described as a tapped fricative. In Ibibio, then both processes seem to be playing a role, while in the development of PLC \*b to Usakade /β/, it appears only substantive reduction has been involved in the change.

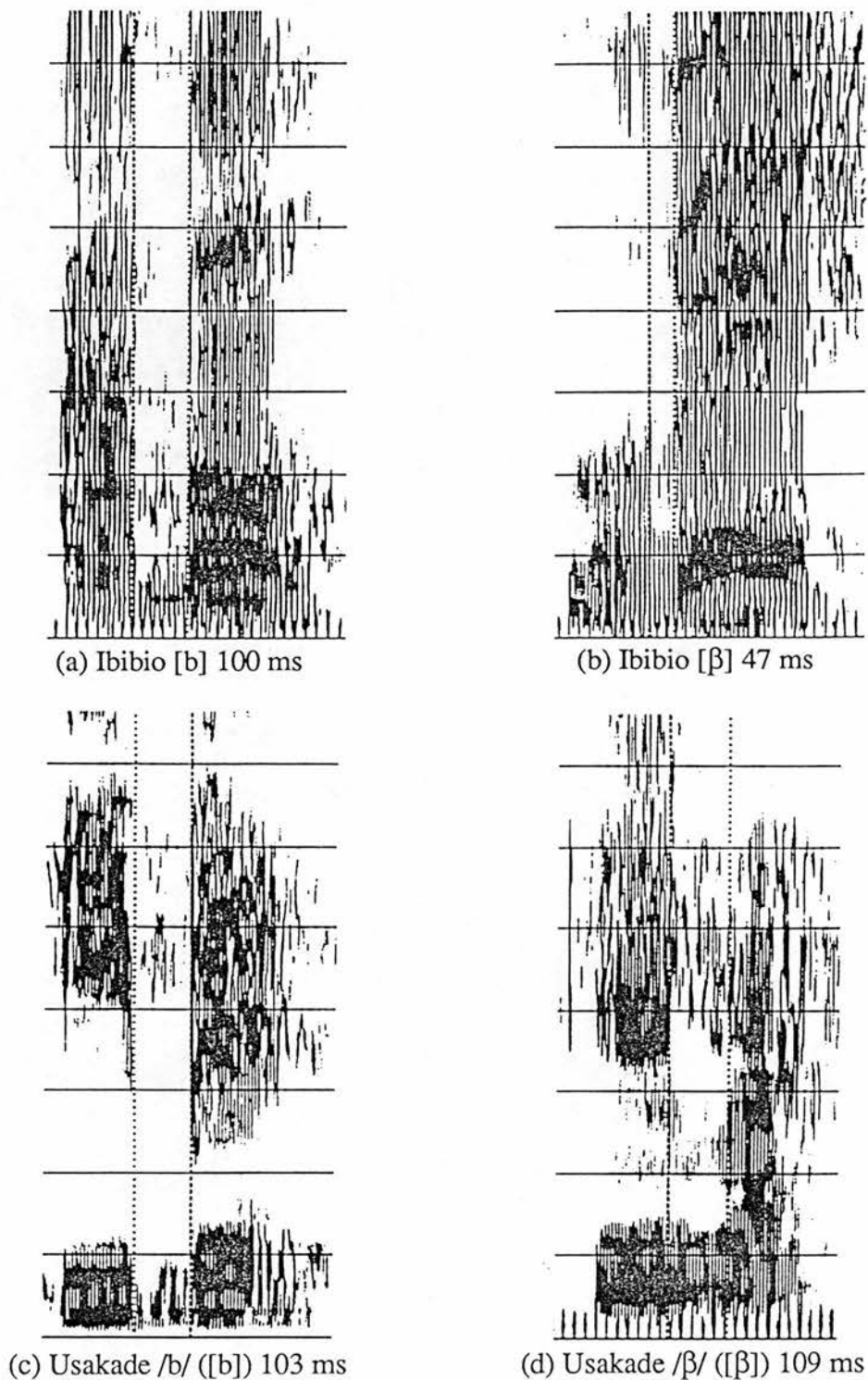


Figure 5.2g: Spectrograms of Ibibio and Usakade labials. (a) and (b) represent Ibibio /b/ - of [b] and [β] respectively (/àbû/ 'crayfish' and /ùbè:d/ 'room'), while (c) and (d) are of Usakade /b/ ([b]) and /β/ ([β]) (/ìbê/ 'leopards' and /éβá/ 'breast') respectively. Durations of constriction are indicated by the cursors, values in milliseconds. Frequency scale is in 500 Hz divisions. (Speakers: Ibibio, E.E. Akpan; Usakade, C.E. Motina.)

### 5.3. Developments of PLC \*kp

Proto-Lower Cross \*kp has a number of reflexes across the group: [p, b, kʷ, gb], as well as [kp]. While [kp] itself is still perhaps the most commonly occurring reflex, it is the first three of these that are of greatest interest for the first part of this discussion. In addition to these reflexes, it will also be recalled from §3.6 that while a labial reflex predominates in Lower Cross (other than the labial-velar itself), velar reflexes of labial-velar stops are attested in other language groups, to the extent that Westermann and Ward (1933) were prompted to suggest that it is these reflexes of labial-velars that are the norm. This immediately raises the question as to why such a wide range of reflexes should obtain, not only across language groups, but also among the descendants of the same proto language. The evidence from the analysis of Ibibio /kp/ sheds light on this question, as well as on the issue of the relative importance of perceptual and productive factors in sound change.

The labial-velar in Ibibio was shown (§3.6) to have the following characteristics. First, strictly speaking the two articulations are not simultaneous, but overlapping such that the velar closure rarely, if ever, follows the labial one, and usually precedes it, while the labial release appears to always occur subsequent to the velar release; the degree of asynchrony between the two releases is variable, both within and across speakers. Second, the release of the consonant is voiced, with the duration of the voice-bar again being variable both within and across speakers. For both of these characteristics, there is some evidence to suggest that the observed variation correlates with dialect. Third, the consonant was shown to have a substantial voicing tail (continuation of voicing after the achievement of closure), which also exhibited a high degree of variation. While there was no evidence that this also correlated with dialect, the existence of the voicing tail may shed light on other aspects of the development of PLC \*kp, to be discussed below.

These observations on the production of Ibibio /kp/ suggest the following conclusions regarding the evolution of PLC \*kp. First, evidence for the later labial release gives insight into why the labial element was the one to survive when the sound underwent change; perhaps more appropriately, it may well be the factor which precipitated the change. This reasoning views the change as being mediated primarily in the acoustic phase of the speech transmission process, and assumes that the hypothesis that the CV interface, i.e., the release of a consonant, is perceptually more salient than its closure is uncontroversial. (See, e.g., Ohala and Kawasaki 1984: 117). However, articulatory characteristics appear to be critical as well, and variation in the



degree of asynchrony of the two releases, such that they were more closely aligned, might lead to a reflex of a labialized velar (as seen in Obolo) or even a simple velar of an earlier labial-velar. Data to test this hypothesis, from language groups where both a labial-velar and a velar had survived, has not yet been available; indications from the small amount of data available on Obolo (for the most part impressionistic) suggest that the hypothesis might well be borne out. Regardless, it would seem uncontroversial that the later labial release has contributed to its survival.

Second, within the labial reflexes, both [p] and [b] are found. The variation found in the degree of prevoicing, which seemed to correlate with dialect, suggest an explanation. It may be assumed that at the PLC stage the same sort of variation must have existed at the individual level, which eventually became associated with different dialects, which in turn developed into independent languages.

Both of these conclusions point to changes that are mediated more at the perceptual end of the transmission process. However, it should be borne in mind that a certain amount of articulatory variation (i.e., the degree of asymmetry of the two releases and the duration of the voice bar) apparently underlies both. There is, moreover, another aspect to the articulation of Ibibio /kp/, which may shed further light on the survival of the labial element over the velar in other LC languages. This is the EPG evidence (§3.4) that showed a number of instances where the velar closure was incomplete, suggesting that this articulation may gradually become eroded. In that section, I suggested that this (substantive) reduction of the velar articulation was related to the phonological structure of the word, in that the first of two /kp/s in a word often did not exhibit complete closure. This does not necessarily imply, however, that this phenomenon could not also be related to the evolution of a labial-velar to a labial. Should it be assumed that the two are related, then the question arises as to whether the erosion of the velar closure is in part due to the greater saliency of the labial release, or if the erosion of the velar (for the other reasons mentioned) adds to the greater saliency of the labial. It is this latter possibility that, under the circumstances, seems the more likely of the two. Again, therefore, there appears to be a certain amount of articulatory variation that may underlie a change apparently resulting from perceptual confusion.

The phonetic description of Ibibio /kp/, together with evidence concerning the development of PLC \*kp, then, has the following implications for a theory of sound change. First, the assertion that perceptual confusion plays a role in sound change is borne out by this evidence, but it also appears that, even so, articulatory characteristics



should not be ignored. To take up and expand on Ohala's view, it would be easier for a listener to factor out the velar element of the articulation under such conditions as the labial release occurring later (should this even be necessary under such conditions), and the velar articulation in any case undergoing erosion in some environments.

Second, an answer to the question as to why a (proto-) sound may develop differently in different daughter languages can be suggested, and that is that the circumstances leading up to the differentiation may not have been the same in each of the dialects (or, earlier, idiolects) in question. While this proposal is not an original one (see, e.g., Ohala's 1987), the evidence given does provide strong support for it, and for the more general approach advocated here, that a deeper understanding of sound change can be gained through attention to phonetic detail.

There is one other reflex of PLC \*kp that bears discussion, [gb] as found in Obolo and Iko and, to a much lesser extent, elsewhere in the group. This may be related to other instances of 'sporadic' voicing found in Obolo (as well as Oro and Ebughu, as mentioned above), and the question is returned to below.

## 5.4. Voicing developments

### 5.4.1. [-voice] becomes [+voice]

Developments in the Lower Cross languages in voicing have most frequently been in the direction of voiceless to voiced. Oro and Ebughu are the two main protagonists in this trend, while only in Ibino do we find the opposite development of devoicing. This development (voicing) was described earlier as being 'sporadic', in the sense that while not all possible candidates for change had been affected (with regard to both sounds and words). Still, there was no apparent conditioning environment for the change (other than that conversational as opposed to formal styles - e.g., reading wordlists - were clearly more affected<sup>109</sup>). Problems in understanding this development exist, in determining what might have precipitated (or be precipitating) the change, and why some voiceless obstruents are being affected more than others - or indeed to the exclusion of others.

The phonetic analysis of Ibibio can again offer possible clues, and we recall the discussion in §3.3. There, the most interesting observation for our present purposes was what appeared to be unusually long voice termination times (VTT), combined with

---

<sup>109</sup> Recall that Kuperus offered surrounding high vowels as a possible conditioning environment, but was herself not convinced by the suggestion; my own evidence (§3.7) gave counter-examples to this.

high standard deviations on these measurements. Table 3.3.a presented VTT means drawn from the literature for a variety of languages, while Table 3.3.b and c gave means from Ibibio for two different studies. For ease of reference these are repeated here, as Tables 5.6.a, b, and c, respectively.

Language	[p]	[t]	[k]
English (Keating 1984b)	13	7	6
Japanese (Keating 1984b)	10	10	5
Swedish (Keating 1984b)	16	16	8
Finnish (Suomi 1980)	13 (10)	10 (7)	2 (8)
English (Suomi 1980)	7 (9)	4 (8)	4 (10)

Table 5.6a: VTT values for different languages. Values are in milliseconds and standard deviations, where available, are included in parentheses.

Clearly, values for Ibibio are unusually high, for both means and standard deviations. The high standard deviations, indicative of substantial variation for this measurement, are reminiscent of the variation found in articulation of Ibibio [d], suggesting that this aspect of Ibibio consonant production is also ‘inherently instable’ - i.e., more variable than what obtains in other languages. It is possible, then, to suggest that as the resistance to voicing gradually lessens, the VTT extends into the closure period, to the point where it may become generalized. Little research has been done on the perception of VTT, but that which does exist lends some credence to the hypothesis presented here - that long voicing tails can result in a switch from [-vce] to [+vce].

Slis and van den Berg (Slis and van den Berg 1985, van den Berg 1986, van den Berg 1987) investigated the influence of VTT (as well as other parameters, such as VOT, duration of preceding vowel, and duration of closure) on the perception of voicing in consonant clusters (VCCV sequences). The earlier experiments were done using synthetic speech stimuli, while the later work replicated the results with natural speech. The basic finding regarding VTT was that longer voicing tails resulted in a higher percentage of [+voiced] responses, especially with regard to C1. VTTs of 40 ms resulted in 61.7% of responses as [+voiced], while VTTs of 75 ms gave a 77.5% rating. This finding was shown to be statistically significant, and independent of other parameters investigated, whether or not these also had significant effects.

Subject	Dur	VTT	VOT	N
EA	130.0 (21.9)	46.5 (35.1)	0	10
PN	59.4 (31.6)	100.0 (26.8)	2.2 (7.9)	9
DE	121.5 (15.5)	69.0 (36.6)	8.0 (6.7)	10
II	175.5 (19.5)	70.0 (40.1)	11.0 (3.1)	10
UE	129.0 (19.8)	63.0 (30.2)	8.0 (9.7)	10
DH	-	-	-	-
ME	166.5 (13.5)	48.0 (21.0)	3.5 (4.7)	10
$\bar{X}$	146.8 (29.0)	65.4 (35.7)	5.5 (7.1)	59

(i) [p]

Subject	Dur	VTT	VOT	N
EA	104.6 (27.1)	41.3 (27.2)	7.5 (10.3)	12
PN	110.4 (31.0)	62.5 (27.7)	25.0 (13.3)	12
DE	112.9 (26.7)	51.7 (19.2)	35.0 (6.3)	12
II	128.8 (22.6)	58.8 (39.8)	27.1 (5.8)	12
UE	114.2 (21.7)	52.5 (34.1)	17.9 (10.7)	12
DH	85.0 (14.6)	36.3 (28.1)	15.0 (8.5)	12
ME	134.6 (28.5)	37.9 (20.7)	20.8 (14.5)	12
$\bar{X}$	112.9 (28.5)	48.6 (29.4)	21.2 (13.0)	84

(ii) [k]

Subject	Dur	VTT	VOT	N
EA	146.0 (17.3)	31.8 (33.9)	-30.0 (18.6)	14
PN	167.3 (29.5)	77.0 (40.8)	-35.3 (10.7)	15
DE	157.5 (17.5)	50.0 (16.8)	-10.4 (15.7)	14
II	187.3 (15.5)	45.0 (54.7)	-36.7 (11.4)	15
UE	160.0 (20.3)	56.0 (32.0)	-16.3 (7.2)	15
DH	127.5 (16.5)	42.9 (13.8)	-23.0 (7.5)	14
ME	188.7 (24.9)	51.3 (35.7)	-32.3 (15.6)	15
$\bar{X}$	162.4 (28.6)	50.4 (35.9)	-26.0 (16.0)	102

(iii) [kɛ]

Table 5.6b: Values for Ibibio (i) [p], (ii) [k], and (iii) [kɛ] for duration, VTT, and VOT based on spectrographic analysis. Measurements are in milliseconds, with standard deviations given in parentheses.

	[t]	[k]	[kɛ]	[s]
Dur	78.0 (22.4)	74.6 (24.8)	71.5 (21.2)	90.4 (30.2)
VTT	33.4 (48.7)	29.3 (31.1)	31.8 (23.2)	5.1 (10.6)
VOT	13.5 (17.7)	19.2 (12.4)	-41.2 (15.2)	15.8 (13.7)

Table 5.6c: Values for Ibibio duration, VTT, and VOT based on Lx/EPG analysis. Measurements are in milliseconds, with standard deviations given in parenthesis.

VTTs for Ibibio, then, are often within the range that could induce a percept of [+voice] (in fact, it will be recalled that there were a number of tokens of 'voiceless' consonants where the voicing tail continued throughout the closure). It may be argued that Oro and Ebughu reflect a more advanced stage of this development, that formerly a VTT situation similar to that found in Ibibio existed in these languages, but which has now become reinterpreted as voicing proper. There is, however, no evidence for a new voicing opposition having developed.

In using the Ibibio voicing data and Slis and van den Berg's experimental results, two possible criticisms need to be borne in mind. First, it may be argued that the perceptual experiments used VCCV sequences, which don't correspond to the LC voicing phenomena under discussion, which are VCV; however, it was pointed out that the VTT effect was independent of other parameters, and had a much greater influence on C1. There is no reason, then, to suggest, that the C of a VCV sequence would not be subject to the same influence<sup>110</sup>. Second, Ibibio [s] does not demonstrate the excessive VTTs found with other voiceless obstruents of the language, whereas this appears to be one of the two or three sounds in both Oro and Ebughu that is most affected. Two points here may be borne in mind. First, the data on Ibibio [s] come from only one speaker, whereas the measurements for Ibibio [p], [k], and [kp] come from a total of nine speakers; given the range of variation in evidence, it would not be surprising if other Ibibio speakers showed a higher mean VTT for [s]. Second, there seems to be no *a priori* reason why the situation should be exactly parallel in the different languages (i.e., that Ibibio should be assumed to be on exactly the same road as Oro and Ebughu, only travelling somewhat more slowly).

In Obolo, too, there has been what appears to be 'sporadic' voicing, though the developments here do not parallel those found in Oro and Ebughu. Many of the instances of voicing in Obolo have resulted in a voicing opposition at a particular place of articulation - e.g., /gb/, or have occurred where an opposition apparently already existed in the parent language - e.g., /dʒ/ < PLC \*k, as in *édʒít*, 'heart'. And as this latter example shows, voicing developments in Obolo have often accompanied other articulatory changes.

A different hypothesis presents itself in the following cases: PLC \*k > [dʒ], \*f > [w] in Obolo. For these, the developments have involved a reduction in

---

<sup>110</sup> It may also be pointed out that throughout LC, C1 of VCCV sequences (i.e., actually VC#CV) is voiced when C2 is voiced. Cf. the discussion of ambisyllabicity in Chapter Two.



constriction in the vocal tract, permitting a reduction in oral air pressure, which had the consequence of allowing voicing to continue throughout the closure. (This hypothesis is not inconsistent with the suggestion that VTT played a role; in fact, requiring the two to work in concert may account for the sporadic nature of these developments.)

#### 5.4.2. [+voice] becomes [-voice]

Similarly, aerodynamic considerations may also underlie developments that have resulted in devoicing in Obolo, and in Oro, e.g., PLC \*b > [f]. As background, we recall (§3.3) fiberoptic evidence (e.g., Löfqvist and Yoshioka 1981) that voiceless fricatives ([s, f]) involve a wider glottal opening than voiceless stops. In addition, the pressure records for Ibibio provided by Ladefoged and referred to in §3.5., showed without exception that Ibibio [f] had higher oral pressure than [b], despite presumably having a lesser constriction, and therefore greater venting of the oral cavity. The only reasonable explanation for the higher oral pressure with [f] would be (considerably) greater airflow, presumably permitted by a wider glottis<sup>111</sup>. The reduction in constriction in these two languages, then, somehow was (or became) associated with a greater glottal opening, while in other languages, for example Enwang and Uda - (PLC \*b > [v]), - this change in aperture did not occur.

The most extensive occurrence of devoicing in Lower Cross has been in Ibino, where generally speaking, all initial oral obstruents (PLC \*[+voice]) have devoiced - i.e., PLC \*b, \*j, \*g<sup>w</sup> > Ibino [p, tʃ, k<sup>w</sup>]. The lone exception to this has been PLC \*d, which has remained voiced - and maintained the voicing opposition that existed at that place of articulation. These three changes should presumably be seen as a single development, perhaps again as a result of aerodynamic conditions. One or both of two factors may have been involved here. First, greater duration of constriction could have led to neutralization of the transglottal pressure differential, which in turn could have led to the extinguishing of voicing; second, each of the parent sounds in this case are ones which have generally undergone erosion of the constriction elsewhere in LC. The fact that this has not occurred in Ibino might have worked against the maintenance of voicing, as both duration and completeness of closure play a role in bringing on a devoicing process (or, conversely, maintaining voicelessness). In other words, the reduction in constriction that has taken place elsewhere effectively vents the supralaryngeal cavity, allowing the maintenance of the transglottal pressure differential required for the survival of voicing.

---

111 A less plausible alternative would be the involvement of greater sub-glottal (expiratory) pressure in the production of [f].

#### 5.4.3. Voicing developments and Articulatory Evolution

As a process, voicing, has traditionally been seen as weakening, or as assimilation, while devoicing (except perhaps in final position) as strengthening. For Pagliuca and Mowrey, voicing “is at least partially equivalent to the other reductive processes in the theory” (1987: 467), in that it (presumably) involves a reduction of neuromuscular activity. However, this is one aspect of change to which they make only passing reference (perhaps surprisingly, since changes in voicing are rampant in the histories of languages), and devoicing is not mentioned at all. The suggestion appears to be that voicing should be seen as resulting from both substantive and temporal reduction. Devoicing, then, presumably would be viewed as a type of fortition, and its analysis would be subject to the same constraints seen on fortitions generally. A deeper look at changes in phonation suggests that its characterization is not quite so straightforward.

Since voice production is only partially controlled by muscular activity (see, for example, Hardcastle (1976) for a summary, or van den Berg (1958) for the classic account of the myoelastic-aerodynamic theory of voice production) it is difficult to see how a theory relying solely on neuromuscular explanation can adequately account for changes in voicing<sup>112</sup>. On the other hand, since a complex of muscles are involved in the control of the vocal folds, both voicing and devoicing could arguably be seen as at least partially resulting from such a process. The posterior cricoarytenoid (PCA) is considered an abductor muscle, involved in the production of voiceless obstruents both medially and finally (Hirose and Gay 1972). In Chapter Three, I discussed further evidence (from Hutters 1984, 1985, primarily) that devoicing of intervocalic stops is actively controlled, through activity of the PCA. Gradual reduction in the activity of this muscle, if Pagliuca and Mowrey are on the right track, could then contribute to a diachronic voicing process.

However, while the PCA is the main (or sole) abductor muscle, it does not function alone in the abduction of the vocal folds, as the Transverse Arytenoid (TA), and possibly the Lateral Cricothyroid (LCA), both adductor muscles, play a role in ‘fine tuning’ the PCA (Hardcastle 1976). One could also argue, then, that it is an increase in activity of either or both of the TA and LCA muscles that brings about voicing.

---

<sup>112</sup> That is, voicing and devoicing; other changes in phonation, which require different vocal fold configurations, could conceivably result from these reduction processes.



Following from this, diachronic devoicing, such as the widely attested devoicing of final stops, could conceivably result from an increase in PCA activity, bringing on an abduction of the vocal folds, or a decrease in activity of the TA and LCA, such that the vocal folds were no longer sufficiently adducted to produce voice. And, conceivably both processes could result from appropriate changes in activity of both abductor and adductor muscles (this would in fact follow from Hirose and Gay's observation that the two sets of muscles act in a reciprocal fashion). Determining the relative importance of the various muscles is clearly an empirical matter, and while it would perhaps not be an easy matter to test, two possibilities come to mind. First, to test this in a diachronic framework, cross-generational EMG work with a language which appeared to be undergoing devoicing of final obstruents could be undertaken. A second test would involve EMG examination of different languages, encompassing a range of voicing possibilities for final obstruents; i.e., one having a voicing opposition in this position, one where an earlier opposition has disappeared, and one where the opposition appears to be disappearing. (Or, a cross dialectal study of the same sort might be undertaken.) Despite the results that such tests might show, it must still be remembered that aerodynamic conditions play at least as important a role in voice production (if not greater), and neutralization of the transglottal pressure differential necessary for voicing to occur must also be seen as a potential explanation for devoicing of stops. This is the sort of factor which in all probability underlies the well attested tendency for geminate stops to be voiceless, as well as asymmetries in consonant systems (see Ohala 1983: 194ff for further discussion).

Voicing and devoicing processes, then, are somewhat problematic for Articulatory Evolution, and whether either of them can legitimately be viewed as resulting (even partially, in some cases) from reductive neuromuscular processes is a matter for further investigation. So, it is unclear what has mediated changes in voicing in the Lower Cross languages. The possibility that a change in muscular activity has led to the voicing of earlier voiceless obstruents in Ebughu, Oro, Obolo (and to a much lesser extent in many of other LC languages) cannot be discounted, and the evidence of long VTTs seems to lend some credibility to the hypothesis, though not without leaving unanswered questions.

The devoicing phenomenon found in Ibino could also be attributable to this kind of phenomenon, or could be understood in terms of aerodynamic factors. The initial [p] found in Ibino is longer (at least by the few measurements I have been able to do) than initial [b] found in Ibino (or elsewhere in Lower Cross), and likewise the velar

closure of [k<sup>w</sup>] is longer than that of its cognate [g<sup>w</sup>] found elsewhere in the group, and it might be arguable that it was this 'extra' length which precipitated the change. (On the other hand, one may wonder whether the extra length came before or after the devoicing.) It is also interesting to note that PLC \*g<sup>w</sup> has devoiced completely in Ibino, as has \*ɟ (to [tʃ]), but not \*b, and since aerodynamic considerations predict that velars, then palatals, then labials should be the order of devoicing, some credibility is lent to the suggestion that these factors have mediated the devoicing in Ibino.

## 5.5. Other developments in Lower Cross consonantal systems

### 5.5.1. Consonants in ambisyllabic position

The reconstruction presented in the preceding chapter did not treat PLC ambisyllabic consonants in detail. In all likelihood, similar realizations of these consonants existed in the parent language as are found today, relatively consistently, in the various daughter languages. These consonants are uncontroversially the reflexes of 'stronger' or more 'substantial' earlier (pre-Lower Cross) consonants, and are the result of evolutionary processes. Consideration of their phonetic characteristics, however briefly, does perhaps shed some light on these processes, particularly with regard to their separation. Recalling that tapped realizations, involving a very brief contact, are common, especially in certain vowel contexts, suggests that temporal reduction has played (or is currently playing) a greater role in their evolution - i.e., were the temporal frame not compressed, greater contact would be achieved<sup>113</sup>. Therefore, as was seen above regarding the evolution of [d] to [ɾ], it appears the processes of substantive and temporal reduction are indeed separable, and while both may play a role in any given development, they do not necessarily exert the same degree of influence at all times.

### 5.5.2. Attrition of final consonants

Loss of final consonants is a widespread phenomenon in the languages of the world, and has frequently been considered a form of weakening, or as a result of a tendency towards what has been considered the 'preferred' or 'most natural' syllable structure (cf. Hyman 1975: 161ff.). Others (e.g., Ohala and Kawasaki 1984) have offered a perceptual explanation for the phenomenon (briefly, that VC transitions do not involve rapid modulations in the acoustic signal, and are therefore lacking in saliency).

---

<sup>113</sup> Although vocalic changes are not the subject of the present work, similar reasoning maybe used to account for vowel reduction phenomena common to varying degrees in LC languages - essentially a phenomenon of undershoot.

While the argument of preferred syllable structure is essentially circular<sup>114</sup>, some credibility can be found for the perceptual account. Chen and Wang (1975), for example, have shown for Chinese, that final stops tend to merge with regard to place of articulation - which could result from their lack of perceptual saliency. Whether the argument can be extended to the outright loss of consonants is perhaps less clear.

These issues aside, the question of final consonant attrition is somewhat tricky for proponents of (traditional views of) weakening, in that often the processes involved, or stages observed, are those referred to as fortitions when they occur non-finally - especially the process of devoicing. So, while voiceless stops are inevitably characterized as being stronger than their voiced counterparts, loss of a voicing opposition in final position - resulting in phonetically voiceless stops - is, by Venneman's definition (Hyman 1975: 163) weakening, as it is a step on the road to zero. The cause of the contradiction is in the use of incompatible criteria in establishing the strength hierarchy - sometimes articulatory, sometimes phonatory, sometimes physiological, sometimes acoustic.

Among certain of the Lower Cross languages (Ebughu, Efai, Ekit, Enwang, Etebi, Ilue, Okobo, Oro, Uda, and Usakade), as mentioned earlier, there is a tendency for final consonant attrition. To date, insufficient work has been done to adequately understand the mechanisms underlying this phenomenon, however, the following observations can be made. First, there has been the loss of an earlier voicing distinction, with final (oral) stops, except very rarely, being phonetically voiceless, and unreleased. There is no suggestion of a tendency of a merger of place of articulation towards [k], as Chen and Wang suggested for Chinese, however [k] appears to resist attrition most strongly. Although in absolute terms labials appear to disappear earliest, when comparison is made with those languages (e.g., Ibibio, Efik) that are yet to undergo final consonant loss to any great extent, it seems that labials and alveolars go at approximately the same rate. For example, comparing Ebughu with Efik, we find approximately 67% of both labials and alveolars have gone in Ebughu, but the velars have remained virtually intact.

It has often been suggested (e.g., Hock 1986) that [ʔ] is often a final stage before the complete loss of a final consonant. This is the case in Lower Cross in only

---

<sup>114</sup> That is, CV syllables are considered most natural (in part) due to the tendency towards final consonant attrition; final consonant attrition occurs because CVs are 'more natural' than CVCs. See Ohala (1990a, b) for detailed discussion of related issues.

three languages of the group, Ekit, Etebi, and (possibly) Uda. In both of these, the above mentioned tendency for velars to persevere doesn't hold; instead [k] (occasionally [t], but rarely, if at all, [p]) has given way to [ʔ], and for Etebi the tendency for [p] and [t] to go at more or less equal rates doesn't hold, as [t] disappears at a much slower pace.

Somewhat similar tendencies appear to obtain for nasals as for the oral stops. That is, although there is not complete agreement among those languages in more advanced stages of final consonant attrition, the clear trend is for velars to survive longest - in fact, velar nasals remain more or less unaffected throughout Lower Cross. Apart from this, there are indications that [m] perseveres longer than [n] - it is interesting to note this is the case for Etebi, where the reverse was true for the oral stops.

In certain respects, then (at least to the extent that they have been examined), the Lower Cross data on final consonant attrition, appear to conform to trends that have been observed in unrelated languages throughout the world. Therefore, one would expect to find a phonetic basis to these developments, either perceptual in nature of the sort discussed above, or articulatory. In the latter case, EPG evidence similar to that examined above, in the cases of substantive reduction would provide support to the proposition. Unfortunately, none of the languages undergoing final consonant attrition have been examined using electropalatography, unlike in the earlier instances where Ibibio, also, was participant in the developments. The EPG investigation done on Ibibio lends no support at all to the articulatory hypothesis, particularly for final [t], which demonstrates as much contact as initial [t]. A perceptual account, then, is perhaps more attractive. Whether one should necessarily expect a loss of distinction with regard to place of articulation, as Chen and Wang found for Chinese, is not entirely clear. However, certainly the fact that these stops are unreleased in Lower Cross (together with the VC hypothesis presented above) makes them less distinguishable, and therefore, barring discovery of evidence to the contrary, the perceptual account of final consonant attrition appears to be more appropriate.

## 5.6. Summary

In this chapter, I have looked at certain of the consonantal developments in the Lower Cross languages, using instrumental evidence from (primarily) one of the languages, Ibibio, in an attempt to come to a clearer understanding of the factors mediating these changes. This has been done in the light of two theories of sound

change: the model adopted by Ohala and others, based in the concepts of signal detection theory, and the theory of Articulatory Evolution, as proposed by Pagliuca and Mowrey, which sees sound change as essentially resulting from neuromuscular events. Some of the Lower Cross developments appear to fit in with the latter view, while others, particularly certain changes which appear to be fortitions, are either better accounted for from a perceptual perspective or are not readily understood by either theory. In the concluding pages which follow, I address, among other issues, the question of whether these two theories, which have been characterized as 'competing', are in fact at odds with each other.



## Chapter Six

### Conclusions

#### 6.1. Introduction

Three distinct but interrelated tasks were set for this dissertation; first among these was a phonetic exploration of sound change. The approach taken for this required that there be available a substantially detailed phonetic description of the languages in question, as well as a reconstruction of the consonant system of the latest common parent of these languages. As neither the description, nor the reconstruction were previously available, these tasks may also be seen as worthwhile contributions to the fields of phonetics and African linguistics in themselves. In this final chapter, I will summarize what may be seen as the accomplishments of the dissertation, and mention some of its weaknesses. Although the approach of the dissertation has been in large part descriptive, an underlying goal has been to contribute to a theory of sound change; one of the purposes of the present chapter therefore is to draw together and elucidate just what the implications of the present research are for such a theory. Finally, suggestions are given as to possible directions for future research.

#### 6.2. Phonetic description

The phonetic description of Lower Cross consonants presented in Chapter Three was based on both impressionistic and instrumental evidence though the latter was confined, for the most part, to Ibibio. It may be argued that conclusions drawn from the instrumental work are to be treated with caution since, in cases using several

speakers, it was necessary to use different investigative techniques and therefore different measurement criteria. Despite this, there was a high degree of correspondence between the results of the different techniques which, in the end, can be seen as lending additional credibility to conclusions drawn. The EPG investigation, on the other hand, used only one speaker, and this may be seen as a drawback in terms of generalizations made based on these results. However, there was nothing noticeably abnormal in my informant's speech, and therefore no reason to assume that characteristics of his speech revealed through EPG are in any way deviant from other speakers of his dialect. Further EPG investigation, of two other Lower Cross speakers (one Ibibio, though of a different dialect, and one Anaang), has subsequently been done, and although this has not yet been examined in detail, preliminary analysis appears to confirm the conclusions presented here.

#### 6.2.1. Articulatory considerations

The investigation of Lower Cross consonants, and especially those of Ibibio, revealed a number of characteristics of interest. This is true from the point of view of descriptive phonetics, but also from the perspectives of both general phonetic theory and a theory of sound change.

The opposition between /t/ and /d/ in Ibibio has conventionally been described as one of voicing. Considerably more than simply voicing, however, was found to differentiate the two; substantial differences were found in both the nature of the articulatory gesture involved, and the linguo-palatal contact. While it is true that differences of a similar nature may exist between two such consonants in other languages, e.g., English, to the best of my knowledge they have never been shown to be as pronounced as in Ibibio. While English /t/ generally involves greater contact than /d/, the difference between the two is slight. This fact, together with the fact that for no other consonants in Ibibio is a voicing opposition manifested in a similar position in the word, leads me to conclude that voicing is not the main feature that distinguishes these two consonants. If any one feature is to be labelled as 'the' distinctive feature (not that this is necessarily desirable), then some feature referring to the nature of the gesture itself would perhaps be most appropriate. One possibility would be to utilize the terms 'fortis' and 'lenis', for /t/ and /d/, respectively. This has not been done here, however, because of the ambiguity as to the phonetic value of these terms. Finally, the de-emphasizing of the role of voicing in Ibibio (and by extension the other Lower Cross languages, where similar characteristics exist) was buttressed by the results of investigations using laryngography, summarized below.

Other articulatory characteristics of interest were also discussed. The notion of 'tapped' articulation was adopted from Laver (in press), and employed in the description and understanding of the production of several consonants in Lower Cross. The term has been applied before in Lower Cross to labials, alveolars, and uvulars (Cook 1969b, 1985), but still in the traditional sense of referring to a very brief stop. Laver's system allows this concept to be applied also to stricture types other than stops, and we have seen that in Lower Cross it is appropriate to refer to tapped stops, fricatives and approximants. However, the Lower Cross data also obliged us to re-evaluate the definition of tap in other ways, for despite his modifications, Laver adheres to the traditional notion of defining taps in terms of their duration; i.e., the most salient difference between [d] and [r] would be said to be in duration, [r] being shorter. The Ibibio data showed similar durations for these two consonants, yet revealed greater contact for the stop. It is apparent therefore that in this case at least it is not the duration which should be considered of prime importance, but rather the nature of the contact. While other commentators have noted that the degree of contact is different for stops and taps (or flaps, e.g., Fujimura *et al* 1973), it has usually been considered to be the result of a shorter duration, and therefore of secondary importance. This was clearly not the case for Ibibio, but it is interesting to note that the difference that does exist only became apparent through use of electropalatography - i.e., not only could spectrography not reveal the differences (and similarities) in the nature of contact for the two consonants, but neither was the similarity in duration of contact for the two as apparent with this technique.

Still on the subject of tapped articulations, we note that a velar tap is considered impossible in current (i.e., 1989) IPA thinking. I have, however, described a velar articulation for Ibibio and other Lower Cross languages as a tapped stop. This was not done without hesitation, as there was no solid instrumental (i.e., EPG) evidence to back up the claim. Nevertheless, auditorily the articulation described in §3.3 as a tapped velar stop can be heard as a tap at least in high front vowel environments; in mid-back vowel environments it was described as a tapped dorso-uvular stop. There may be some involvement of the uvula in the high front vowel environment where this gesture occurs as well, although there is no strong auditory impression of uvularity. In the environment of low front vowels this articulation is realized as a tapped velar approximant.

### 6.2.2. Voicing characteristics

It was argued above that voicing does not play a large role in the phonology of Ibibio. This claim was based partly on the fact that there is essentially only one instance where a voicing opposition might play a role, and that there are other articulatory characteristics which may be seen as being of greater importance. Additional support comes from the examination of voice timing in Ibibio, which showed longer than expected VTTs and relatively high variation in duration of both VTT and VOT. An alternative suggestion is that the observed timing characteristics, in particular the unusually high variation in VTT and VOT, are to be considered a result of the low phonological importance of voicing. Whichever interpretation is seen as preferable, the facts are that phonologically 'voiceless' consonants, in particular the stops /t k kp/, are very often voiced during the early portion of the closure period and occasionally voiced throughout the closure. It was noted, though, that this voicing was of low amplitude in the Lx signal, indicating incomplete or partial closure of the vocal folds, while fully voiced /b/ and /d/ showed little or no decrease in amplitude in the Lx signal for the consonant across a VCV sequence. The evidence suggested, then, that the voiceless stops were produced with a narrowed glottis, and that devoicing was in all probability a passive process, dependent in part on aerodynamic factors. On the other hand, the voiceless fricative /s/ (and presumably /f/, although it was not examined), demonstrated much greater consistency in VTT and VOT, and for this devoicing is probably achieved through an active opening gesture of the vocal folds. One important implication of this analysis is that languages may employ different control mechanisms regarding the timing and nature of voicing, depending on its importance to the phonology of the language in question. Certainly the timing of voicing in Ibibio does not appear to be as tightly controlled as Löfqvist and Yoshioka (1981) suggest is the case in the languages they examined.

### 6.2.3. Electropalatography

The investigation using electropalatography revealed several interesting characteristics of Ibibio consonant articulation, many of which were of importance regarding sound change in Lower Cross; these are returned to below. Concerning descriptive phonetics and general phonetic theory, as well, several points of interest emerged, such as the importance of the nature of the contact, as discussed above for /t/, /d/, and /r/. Other than this, when considering consonant-vowel coarticulation, the difficulty in establishing a hierarchy of influence for different vowel environments was discussed, and it was concluded that there is nothing inherent in a particular vowel to make it more or less influential than others. Rather, the effect of a vowel upon a



consonant (or, presumably, vice versa) is a function of the interaction between the two, consonant and vowel, and should be recognized as such.

The claim made in Recasens (1984a), that an inverse relationship exists between the amount of tongue contact and degree of coarticulation, was considered, and found to be accurate but in a limited sense only. That is, for Ibibio alveolars, greater tongue contact ([t] as opposed to [d]), implied lesser coarticulatory effects, as predicted. The palatal nasal, which has substantial contact, showed little movement in different contexts, but the degree of contact was influenced by different contexts. However, Ibibio velars also showed considerable linguo-palatal contact, but in this case there was also a high degree of coarticulation according to vowel context. Recasens' claim therefore, has only limited validity, and both active and passive articulators need to be taken into account, as well as the nature of the coarticulation, before such a principle can be validated.

#### 6.2.4. Labial-velars

One of the most interesting aspects of the present work from the perspective of descriptive phonetics is the discussion offered of labial-velar stops - if for no other reason than the lack of attention previously paid to these in the literature. Also important in this regard is that the analysis provided here of the labial-velar is based on the speech of several speakers, whereas previous reports have reported on only one or two speakers at most. These stops are noteworthy particularly in the variability, and the complexity of their production. These are doubly articulated stops, but without tight control as to the synchronization of the two articulatory gestures such that, while the velar closure and release normally precede the labial closure and release, respectively, the degree of offset between the two is variable. In addition, the Ibibio labial-velar is described as partially-voiced and implosive, and apparently involving the use of three airstream mechanisms: pulmonic egressive, velaric ingressive, and glottalic ingressive. With regard to the velaric ingressive airstream mechanism, I have suggested that Pike's (1943) term, 'oral airstream mechanism' is a more appropriate label, as the evidence indicates that there is no backward movement of the velar point of contact, but rather, a lowering of the front of the tongue and perhaps the jaw as well, to expand the size of the oral cavity.

The description of the labial-velar stop given here also differs in important ways from earlier descriptions, particularly that found in Garnes (1975), also of Ibibio. Garnes' description formed the basis of Sagey's (1986) characterization of these stops



in terms of feature geometry as complex segments having the “durations of single x-slots” (1986: 83) - in Garnes’ terms, a “single unit of timing” (1975: 48). This, however, is apparently not the case for Ibibio. Durational measurements reported here diverged considerably from those of Garnes, but matched closely those derived from unpublished pressure recordings done by Ladefoged. The present research showed the velar component to have a duration similar to that of simple velars, and the labial component a duration similar to that of simple (voiceless) labials, and with a substantial difference between the two. It is difficult, then, to see these as constituting ‘one unit of timing’. An analysis claiming that these do constitute a single unit of timing, and therefore occupy a single x-slot, is therefore questionable, and the characterization of labial-velars in terms of feature geometry is in need of rethinking.

### 6.3. Lower Cross consonants and PLC consonants

A description of the consonants of other Lower Cross languages was presented, though for practical reasons this could not be as detailed as that done for Ibibio. However, a great many similar characteristics were found across the group. In particular, similar conditions appear to govern consonant realization in different positions (initial, ambisyllabic, or final) throughout the group, though certain tendencies for change are more advanced in some languages than others. The description given was used as the basis for a reconstruction of the consonant system of Proto-Lower Cross, presented in Chapter Four. Although based in part on the principles of the Comparative Method, the technique used here for reconstruction went beyond the traditional method in taking greater account of the phonetic plausibility of postulated or implied developments. This allows for a more confident and accurate statement as to the phonetic characteristics of the parent language. For example, the set of correspondences involving the labial-velar /kp/ reconstruct fairly readily to PLC \*kp, but the additional phonetic information concerning the production of this stop has allowed us to suggest that, in order to account for the range of reflexes of PLC \*kp, it must have been similar in production to that of Ibibio, including the inherent variation.

In other cases, such as among the velars, where exclusive use of the comparative method might have (at least ambiguously) suggested two proto-sounds, evidence from other related but, non-Lower Cross languages, as well as phonetic considerations, have indicated a single proto-sound to be the more appropriate reconstruction. In this case, it was decided that a voiceless labialized velar should not be reconstructed, as the labialization could be more convincingly accounted for as being an innovation in those languages where it occurs.

#### 6.4. Sound change in Lower Cross and contributions to a general theory of sound change

In establishing a theoretical setting for the dissertation, Chapter One was intended to accomplish two aims: one of these was to determine precisely what is meant by the term 'sound change'; here, I opted for a more restricted and precise definition of sound change than is normally found - but one that is not too far from that of the Neogrammarians. The other aim was to outline the theoretical approach to be utilized. This was based on that fostered primarily by Ohala, as outlined in Chapter One, and is founded in the concepts of signal detection theory. It therefore allows for a characterization of sound change in terms of where during the transmission process a development is mediated, which in turn permits a more principled investigation of sound change. In Chapter Five, a somewhat different approach was discussed, that of Pagliuca and Mowrey, called Articulatory Evolution. This, they claim, is incompatible with the approach taken by Ohala, particularly in that, a) it denies any importance to perceptual processes in mediating sound change, and b), it claims that sound change is gradual, the result of decreasing neuromuscular activity. The evidence from Lower Cross is relevant to evaluating these two theories, and one of the tasks of this final chapter is to decide whether there is any grounds for reconciliation of the two approaches.

Several Lower Cross consonantal developments were examined in Chapter Five from the perspective of production, in view of what was learned of Ibibio and the other Lower Cross languages. This led to a greater understanding as to why these changes occurred. In particular, the evidence from four sets of developments, those emanating from PLC \*d, the palatals \*j and \*ɲ, \*gʷ, and \*kp indicates that a great many consonantal changes are the result of articulatory factors. Especially those involving \*d, \*j and \*ɲ, \*gʷ, are readily understood from the perspective of Articulatory Evolution, and lend support to this theory; that is, the evidence from EPG indicates all of these to be instances of substantive reduction, where the degree of contact for the articulation in question has been, or is, gradually decreasing over time. The development of PLC \*d in Ibibio was described as an 'incipient change' - i.e., the speaker was not aware of a [d] > [ɾ] development. The other two developments can be seen as filling other 'slots' in the developmental process: Ibibio /ɲ/ has basically two realizations, [ɲ] and [j], with a change from the former to the latter 'in progress' - speakers are (or may be) aware of the variation; and Ibibio /w/ < PLC \*gʷ can, for phonological purposes, be considered a completed change - speakers would claim to have /w/ rather than /gʷ/, though the EPG evidence revealed that [gʷ] still occurs. In

other words, we can see graduality at three crucial points in the history of a sound change - beginning, middle, and end. This graduality can best be viewed as resulting from a gradual decrease in neuromuscular activity.

The question of articulatory variability was also addressed, and was seen as a necessary component in the initiation of a sound change - witness the stability in the articulation of [t], which has not changed from PLC, relative to that of [d]. However, the point was made that although variability may be a necessary or inherent aspect of sound change, and may, from a certain perspective, be seen as the change in itself, not all variability should be seen as constituting sound change. That is, a sufficiently detailed phonetic description will allow a distinction to be drawn between random variation and variation which appears to be moving in a recognizable direction.

Among the claims of Articulatory Evolution is the assertion that sound change involves two reductive processes, substantive reduction and temporal reduction, although Pagliuca and Mowrey admit that difficulties exist in separating the two. The distinction is supported by the Lower Cross evidence, which showed that not only are the two in operation, but also that they can operate independently of each other. In particular, the [d] > [r] development in Ibibio showed a reduction in linguo-palatal contact, but without a corresponding reduction in duration of the gesture, and also the comparison of labial fricatives in Ibibio and Usakade, which showed both processes at work in Ibibio, but with apparently only substantive reduction having played role in Usakade.

Articulatory Evolution, however, does not appear to be able to account for other Lower Cross developments - those which appear to be fortitions. Within this theory, fortitions are said not to occur as sound changes (using the term in its restricted sense as established in Chapter One); rather they are seen as essentially a result of borrowing or as artifacts of an erroneous reconstruction. The development of PLC \*g<sup>w</sup> > Ebughu [gb], which would traditionally be seen as a fortition, was discussed, and this development could be seen neither as a borrowing nor was it likely that \*gb was a more appropriate reconstruction. Only by modifying the Principle of Differential Retention, such that it recognizes that fortitions do not necessarily introduce new articulations into a language, could this development be considered acceptable within the theory.

Developments in Lower Cross involving changes in voicing are also somewhat problematic for Articulatory Evolution, in that it is by no means clear that these are a

result of a reduction in neuromuscular activity. Changes of this nature could in fact be brought on through an increase in the activity of the appropriate muscles or, more probably, as a result of aerodynamic factors. If this is the case, the theory could be modified to incorporate aerodynamic factors; certainly there is indication in the Lower Cross data that changes in voicing occur gradually, which is not only compatible with, but essential to Articulatory Evolution.

The fact, that for the most part, the Lower Cross developments discussed here fit an Articulatory Evolution framework does not mean they are necessarily inconsistent with a signal detection approach to sound change. That is, a decrease in neuromuscular activity, can quite conceivably be seen as 'noise' in the system, occurring in the articulatory phase of the transmission - or, to return to Catford's breakdown, during the neuromuscular phase. Similarly with changes in voicing resulting from aerodynamic factors, the variation in these factors that leads to change can be considered transmission noise.

To a certain extent, then, the two approaches appear to be complementary rather than in conflict, and Articulatory Evolution can be viewed as a well-needed elaboration of how sound changes develop at certain stages of the transmission process. The question still remains, though, as to the role of perception, and whether sound change actually does occur as a result of solely perceptual factors. The developments of PLC \*kp, it was argued, probably do involve the perceptual mechanism, but it was pointed out that articulatory variation in all probability gave rise to the necessary conditions; a similar analysis was suggested for the change in Anaang from [r] to [l]. However, among the consonantal developments in Lower Cross, none were found that could be seen to be purely a result of perceptual factors. This in itself cannot be taken as evidence that perceptual factors alone cannot or do not initiate change, but it does suggest that the importance of the role of perception needs to be rethought, and considerably more investigation is needed before a strong claim can be made as to the contribution actually made by perception. The ability to 'induce', or 'duplicate' change as a result of perceptual factors in the laboratory is not in itself sufficient evidence that change does occur in this way; only that it is a possibility. The numerous instances of perceptual misapprehensions which occur to language users daily, yet do not lead to change, is evidence of this (cf. the quotation from Paul regarding the role of the listener, in Chapter One).



## 6.5. Directions for future research

The present work leaves us with a huge scope for future research; this can be divided into two broad categories - descriptive or theoretical work in a variety of areas but focussing on Lower Cross, and research explicitly geared to furthering the development of a comprehensive theory of sound change.

Regarding Lower Cross, and staying in the same vein as the present research, description of the phonetics of the vowel and tone systems of the different languages is a pressing need, and following from this further diachronic work, to reconstruct the vowel and tone systems of PLC. Further work is also planned or underway regarding the consonants of Lower Cross, and their development. In particular, a technique is being developed that will allow for a precise and direct way of measuring the asynchrony of the two gestures involved in the production of the labial-velar, and comparison of the labial-velars of Lower Cross with those from other language groups is planned.

In Chapter Two a number of possible areas for future work specifically regarding phonological questions were indicated; among these were questions dealing with the specification of the relationship between the foot (syllabeme, or whatever term eventually appears most appropriate) and the syllable, and the relationship that exists between this higher unit and the segmental and tonal systems. Before exploring the connection between syllables and feet, a more detailed characterization of the internal structure of the syllable than was offered in Chapter Two is required.

Regarding a theory of sound change, the present work has perhaps clarified some issues - such as the question of phonetic graduality - but just as important, are the indications for further research. Physiological research into speech production, especially of an electromyographic nature, is needed to confirm the indications gleaned from electropalatography that sound change may occur as a result of a decrease in neuromuscular activity. A means of approaching this was suggested in Chapter Five. The precise role of perception in mediating sound change, despite the advances made in this area by Ohala and others, still needs to be defined. How to make the link between replicating observed change in the laboratory and establishing that the same processes are responsible for actual change, is problematic. As a methodological strategy, the evidence presented here in favour of articulatorily-based change suggests at least that these factors should be considered and found wanting, before perceptual factors are invoked as a cause of change.



A comprehensive theory of sound change, however, must go beyond the considerations of phonetics to include phonological and sociolinguistic facets of change. Certainly phonetic factors must loom large in any theory of sound change, as these are of utmost importance in understanding the mediation or actuation of sound change. Phonological considerations may play a role in initiating change, but more important may be their role in inhibiting change that might otherwise have occurred. Similarly with sociolinguistic factors; these are obviously important in understanding the propagation of change, but may also be important as inhibitors of change. Finally, other levels of grammar, as well, need to be taken into account, to explore any possible interaction between these and either the origin or propagation of sound change. It has often been claimed (with support from a considerable body of research) that change may spread gradually through the lexicon of individual language users, just as it spreads gradually through a speech community. What is not clear, however, is what the conditions are that govern lexical diffusion: frequency of occurrence has often been cited as an important factor (and this apparently would also fit in with Articulatory Evolution), but it is also of interest to discover whether such factors as semantic field, syntactic category or word class, or speech register play any role in governing the implementation of a sound change. A research project for Lower Cross is being developed which hopefully will clarify some of these issues. The change from [d] to [r] in Lower Cross appears to be proceeding in a phonetically gradual manner. It was argued in Chapter Five that this development may well be spreading by means of lexical diffusion, though appropriate research of a sociolinguistic nature has yet to be undertaken to ascertain this with confidence. This work is now in the planning stages and will, in addition to generational and geographical factors, attempt to incorporate a large enough corpus for investigation, that will allow an answer to some of these questions.

## References

- Abberton, E., & Fourcin, A. (1984) Electrolaryngography. In C. Code & B. Ball (Eds.), *Experimental Clinical Phonetics* (pp. 62 - 78). London: Croom Helm.
- Abercrombie, D. (1967) *Elements of General Phonetics*. Edinburgh: University of Edinburgh Press.
- Abraham, R. C. (1940) *Principles of Tiv*. London: Crown Agents.
- Andersen, H. (1973) Abductive and deductive change. *Language*, 49, 765-793.
- Anderson, J. M. & Jones, C. (Eds.) (1974) *Historical Linguistics II: theory and description in phonology. Proceedings of the 1st International Conference on Historical Linguistics, Edinburgh, 1973*. Amsterdam: North-Holland.
- Anderson, S. R. (1976) On the description of multiply articulated stops. *Journal of Phonetics*, 4, 17-27.
- Anderson, S. R. (1985) *Phonology in the Twentieth Century: theories of rules and theories of representations*. Chicago: University of Chicago Press.
- Anthony, J. & Hewlett, N. (1984) Aerometry. In C. Code & M. Ball (Eds.), *Experimental Clinical Phonetics* (pp. 79 - 106). London: Croom Helm.
- Anttila, R. (1972) *An Introduction to Historical and Comparative Linguistics*. New York: MacMillan.
- Baken, R. J. (1987) *Clinical Measurement of Speech and Voice*. London: Taylor and Francis.
- Barnwell, K. G. (1969) *A Grammatical Description of Mbembe (Adun Dialect) - A Cross River Language*. PhD, University College, London.
- Barry, W. & Kuenzel, H. (1975) Co-articulatory airflow characteristics of intervocalic voiceless plosives. *Journal of Phonetics*, 3, 263-281.
- Bearth, T., & Zemp, H. (1967) The phonology of Dan (Santa). *Journal of African Languages*, 6, 9-29.
- Bendor-Samuel, J. (Ed.) (1989) *The Niger-Congo Languages*. Lanham, MD: University Press of America.
- Berg, J. v. d. (1958) Myoelastic-aerodynamic theory of voice production. *Journal of Speech and Hearing Research*, 1, 227 - 244.
- Berg, R. J. H. v. d. (1986) The effect of varying voice and noise parameters on the perception of voicing in Dutch two-obstruent sequences. *Speech Communication*, 5 (4), 355-367.
- Berg, R. J. H. v. d. (1987) The perception of voicing in Dutch two-obstruent sequences: a comparison of synthetic and natural speech. *Proceedings (Institute*

- of Phonetics, University of Nijmegen*), 11, 47 - 55.
- Bogers, K, Hulst, H. v. d., & Mous, M. (Eds.) (1986) *The Phonological Representation of Suprasegmentals. Studies Offered to John M. Stewart on his Sixtieth Birthday*. Dordrecht: Foris.
- Boys, W. E. (1979) *Ibibio Phonology*. PhD, Ohio State University.
- Butcher, A. (1977) Coarticulation in intervocalic voiceless stops and fricatives in connected speech. *Arbeitsberichte*, 8, 154-212.
- Butcher, A, & Weiher, E. (1976) An electropalatographic investigation of coarticulation in VCV sequences. *Journal of Phonetics*, 4, 59-74.
- Catford, J. C. (1974) 'Natural' sound change: some questions of directionality in diachronic phonetics. In A. Bruck, R. A. Fox, & M. W. LaGaly (Eds.), *Papers from the Parasession on Natural Phonology* (pp. 21-29). Chicago: Chicago Linguistic Society.
- Catford, J. C. (1977) *Fundamental Problems in Phonetics*. Edinburgh: University of Edinburgh Press.
- Chen, M. Y, & Wang, W. (1975) Sound change, actuation and implementation. *Language*, 51, 255-281.
- Clements, G. N. & Keyser, S. J. (1983) *CV Phonology: a generative theory of the syllable*. Cambridge, Mass: MIT Press.
- Coates, R. (1988) Historical linguistics. In J. Lyons, R. Coates, M. Deuchar, & G. Gazdar (Eds.), *New Horizons in Linguistics, Vol. 2* (pp. 179-199). Harmondsworth: Penguin.
- Code, C., & Ball, M. (Eds.) (1984) *Experimental Clinical Phonetics: Investigatory techniques in speech pathology and therapeutics*. London: Croom Helm,
- Connell, B. (1984) *Lexicostatistics and Comparative Linguistics: the case of Lower Cross*. Yaoundé, Dec. 1984.: Paper presented to the 16th WALC.
- Connell, B. (1985) A comparative study of the Lower Cross language group. *Journal of the Linguistic Association of Nigeria*, No. 3, 105-111.
- Connell, B. (1987a) Noun Classification in Lower Cross. *Journal of West African Languages*, XVII No. 1, 110-125.
- Connell, B. (1987b) *The Historical Development of Lower Cross Consonants*. Leiden: Paper presented to the 17th CALL.
- Connell, B. (1987c) Temporal aspects of labiovelar stops. *Work in Progress*, 20, 53-60.
- Connell, B. (1989) Instrumental evidence for phonetically gradual sound change. *Work in Progress*, No. 22, 58-68.
- Connell, B. (1990) *Sound Correspondences, Lexicostatistics, and Lexical*

*Innovation in the Lower Cross Languages*. Leiden: Paper presented to the 20th CALL.

- Connell, B., & Maison, K. B. (forthcoming) A Cameroun homeland for the Lower Cross peoples?
- Cook, T. L. (1969a) *The Pronunciation of Efik for Speakers of English*. Bloomington, Indiana: African Studies Program and Intensive Language Training Center, Indiana University.
- Cook, T. L. (1969b) *The Efik Consonant System*. Seminar paper presented to the Dept. of Linguistics and Nigerian Languages, University of Ibadan, 20 Mar. 1969, Ibadan.
- Cook, T. L. (1969c) Suggested names for some sub-groupings of Cross River languages. *Benue-Congo Newsletter*, 6 Dec. 1969, 1-8.
- Cook, T. L. (1985) *An Integrated Phonology of Efik, Vol. One*. PhD, University of Leiden.
- Cook, T. L. (1986) The chameleonic vowel in the harmonizing prefixes of Efik. In K. Bogers, H. v. d. Hulst, & M. Mous (Eds.), *The Phonological Representation of Suprasegmentals. Studies on African Languages Offered to John M. Stewart on his Sixtieth Birthday*. (pp. 209-232). Dordrecht: Foris.
- Cook, T. L. (n.d.) Focus in Efik (unpublished mss).
- Dimmendaal, G. J. (1978) *The Consonants of Proto-Upper Cross and Their Implications for the Classification of the Cross River Languages*. Scriptie (final essay for the 'doctorandus' degree), University of Leiden.
- Dogil, G. (1988) On the acoustic structure of multiply articulated stop consonants (labio-velars). *Wiener Linguistische Gazette*, 42-43, 3-55.
- Drachman, G. (1978) Child language and language change: a conjecture and some refutations. In J. Fisiak (Ed.), *Recent Developments in Historical Phonology* (pp. 123-144). Berlin: Mouton.
- Dressler, W, Luschützky, H. C, Pfieffer, O. E, & Rennison, J. R. (1987) *Phonologica 1984: proceedings of the 5th International Phonology Meeting, Eisenstadt, June 1984*. London, CUP.
- Durand, J. (1990) *Generative and Non-linear Phonology*. London: Longman.
- Edwards, T. J. (1981) Multiple feature analysis of intervocalic English plosives. *Journal of the Acoustical Society of America*, 69, 535-547.
- Ekere, M. E. (1987) *Ideophonic Expression in Ibibio*. PhD, University of Calabar.
- Elugbe, B. O. (1989) *Comparative Phonology of the Edoid Languages*. Port Harcourt: University of Port Harcourt Press.
- Elugbe, B. O., & Williamson, K. (1984) The loss of the fortis/lenis contrast in Abuan



- resonants. In J. W. Higgs, & R. Thelwall (Eds.), *Topics in Linguistic Phonetics* (pp. 65-90). Coleraine: New University of Ulster.
- Essien, M. M. (1989) *Etude de quelques operateurs de la grammaire ibibio en contraste avec l'anglais et le francais*. Thèse de doctorat (nouveau regime), Université de la Sorbonne, Paris III.
- Essien, O. E. (1983) *Ibibio Orthography*. Calabar: Ibibio Language Panel,
- Essien, O. E. (1984a) Towards an Ibibio orthography. *Nigerian Language Teacher*, 5 2, 44-52.
- Essien, O. E. (1984b) Towards an Ibibio orthography. *Nigerian Language Teacher*, 6. 1, 47-56.
- Essien, O. E. (1990) *A Grammar of the Ibibio Language*. Owerri: University Press.
- Fallows, D. (1981) Experimental evidence for English syllabification and syllable structure. *Journal of Linguistics* 17, 309-18.
- Faraclas, N. G. (1982) Elision and other morpheme boundary phenomena in the Western dialects of Obolo. *Journal of West African Languages*, XII 2, 69-82.
- Faraclas, N. G. (1984a) *Obolo Grammar*. Bloomington: Indiana University Linguistics Club.
- Faraclas, N. G. (1984b) Tone and phrase stress: the extra high tone in Obolo. *Journal of West African Languages*, 14 1, 3-17.
- Faraclas, N. G. (1989) The Cross River Languages. In J. Bendor-Samuel (Ed.), *The Niger-Congo Languages*. Lanham, University Press of America.
- Faraclas, N. G. (n.d.) Comparative Lower Cross. (Unpublished mss.)
- Faraclas, N. G., & Williamson, K. (1984) Assimilation vs. dissimilation: reduplication in Lower Cross. *Journal of African Languages and Linguistics*, 6, 1-18.
- Farnetani, E., Vaggies, K., & Magno-Caldognetto, E. (1985) Coarticulation in Italian /VtV/ sequences: a palatographic study. *Phonetica*, 42, 78-99.
- Fisiak, J. (1978) *Recent Developments in Historical Phonology (Papers from the International Conference on Historical Phonology 1976)*. Berlin: Mouton.
- Fourakis, M. & Port, R. F. (1986) Stop epenthesis in English. *Journal of Phonetics*, 14, 197-221.
- Fry, D. B. (1979) *The Physics of Speech*. Cambridge: Cambridge University Press.
- Fujimura, O, Tatsumi, I. F, & Kagaya, R. (1973) Computational processing of palatographic patterns. *Journal of Phonetics* 1, 47-54.
- Gardiner, I. (1980) *Abuan-English English-Abuan Dictionary*. Port Harcourt: University of Port Harcourt Press. (In association with The National Bible Trust, Jos.)



- Garnes, S. (1975) An acoustic analysis of double articulations in Ibibio. *Ohio State University Working Paper in Linguistics*, 20 (Proceedings of the Conference on African Linguistics), 44-55.
- Gleason, H. A. (1961) *An Introduction to Descriptive Linguistics*. New York: Holt, Rinehart and Winston.
- Goldie, H. (1857) *Principles of Efik Grammar, with Specimen of the Language*. Calabar: United Presbyterian Mission.
- Goldie, H. (1862) *Dictionary of the Efik Language (in two parts)*. Edinburgh: United Presbyterian College Buildings.
- Greenberg, J. H. (1963) *The Languages of Africa*. Bloomington, Ind: Indiana University.
- Griffen, T. D. (1985) *Aspects of Dynamic Phonology*. Amsterdam: John Benjamins.
- Guthrie, M. (1967-71) *Comparative Bantu: an introduction to the comparative linguistics and prehistory of the Bantu languages*. Farnborough: Gregg International Publishers.
- Hagège, C. & Haudricourt, A. (1978) *La phonologie panchronique*. Paris: Presses Universitaires de France.
- Hansford, K, Bendor-Samuel, J, & Stanford, R. (1976) *An Index of Nigerian Languages*. Accra: Summer Institute of Linguistics.
- Hardcastle, W. (1976) *Physiology of Speech Production*. New York: Academic Press.
- Hardcastle, W. (1985) Some phonetic and syntactic constraints on lingual coarticulation during /kl/ sequences. *Speech Communication*, 4, 247-263.
- Hardcastle, W, Jones, W, Knight, C, Trudgeon, A, & Calder, G. (1989) New developments in electropalatography: a state-of-the-art report. *Clinical Linguistics and Phonetics*, 3 No.1, 1-38.
- Hedinger, R. (1987) *The Manenguba Languages (Bantu A.15, Mbo Cluster) of Cameroon*. London: School of Oriental and African Studies.
- Hess, W. (1983) *Determination of Speech Signals*. Berlin: Springer.
- Higgs, J. W. & Thelwall, R. (Eds.) (1984) *Topics in Linguistic Phonetics. In Honour of E.T. Uldall*. Coleraine: New University of Ulster.
- Hirano, M. (1981) *Clinical Examination of Voice*. New York: Springer.
- Hirose, H. & Gay, T. (1972) The activity of the intrinsic laryngeal muscles in voicing control. *Phonetica*, 25, 140-164.
- Hock, H. H. (1986) *Principles of Historical Linguistics*. Berlin: Mouton de Gruyter.
- Hockett, C. (1955) *A Course in Phonology*. Bloomington: University of Indiana.

- Hockett, C. (1958) *A Course in Modern Linguistics*. New York: MacMillan.
- Hoenigswald, H. (1960) *Language Change and Linguistic Reconstruction*. Chicago: University of Chicago Press.
- Hogg, R., & McCully, C. B. (1987) *Metrical Phonology: a course book*. Cambridge: Cambridge University Press.
- Houde, R. A. (1968) *A Study of Tongue Body Motion During Selected Speech sounds*. Santa Barbara: Speech Communication Research Laboratory.
- Hutters, B. (1984) Vocal fold adjustments in Danish voiceless obstruent production. *Annual Report of the Institute of Phonetics, University of Copenhagen*, 18, 293-385.
- Hutters, B. (1985) Vocal fold adjustments in aspirated and unaspirated stops in Danish. *Phonetica*, 42 1, 1-24.
- Hyman, L. M. (1973) *Consonant Types and Tone*. Los Angeles: University of Southern California.
- Hyman, L. M. (1975) *Phonology: theory and analysis*. New York: Holt, Rinehart and Winston.
- James, A. L. (1968) *Historical Introduction to French Phonetics*. London: Dawsons of Pall Mall.
- Janson, T. (1983) Sound change in production and perception. *Language*, 59, 18-34.
- Javkin, H. (1979) Phonetic universals and phonological change. *Report of the Phonology Laboratory, Berkeley*, No. 4.
- Jeffers, R., & Lehiste, I. (1979) *Principles and Methods for Historical Linguistics*. Cambridge, Mass: MIT Press.
- Jenewari, C. E. W. (1983) *Defaka: Ijo's closest linguistic relative*. Port Harcourt: University of Port Harcourt Press.
- Kahn, D. (1976) *Syllable Based Generalizations in English Phonology*. Bloomington: Indiana University Linguistics Club.
- Kaufman, E. M. (1968) *Ibibio Grammar*. PhD, University of California, Berkeley.
- Kaufman, E. M. (1985) *Ibibio Dictionary*. Leiden: Cross River State University and the Ibibio Language Board, in co-operation with the African Studies Centre, Leiden.
- Keating, P. (1984a) Phonetic and phonological representation of stop consonant voicing. *Language*, 60, 286-319.
- Keating, P. (1984b) Physiological effects on stop consonant voicing. *UCLA Working Papers in Phonetics*, 59, 29-34.
- Kent, R., & Moll, K. (1972) Cinefluorographic analyses of selected lingual consonants. *Journal of Speech and Hearing Research*, 15, 453-473.

- Kim, C. (1970) A theory of aspiration. *Phonetica*, 21, 107-116.
- King, R. (1969) *Historical Linguistics and Generative Grammar*. Englewood Cliffs, N.J: Prentice-Hall.
- Kiparsky, P. (1968) Linguistic universals and linguistic change. In E. Bach, & R. Harms (Eds.), *Universals in Linguistic Theory* New York: Holt, Rinehart and Winston.
- Kiparsky, P. (1988) In F. J. Newmeyer (Ed.), *Linguistics: the Cambridge Survey, Vol. One, Linguistic Theory: foundations* Cambridge: CUP.
- Kiparsky, P. (1988) Phonological change. In F. J. Newmeyer (Ed.), *Linguistics: the Cambridge survey* (pp. 363-415). Cambridge: Cambridge University Press.
- Klatt, D. (1975) Voice onset time, frication, and aspiration in word-initial consonant clusters. *Journal of Speech and Hearing Research*, 18, 686-705.
- Kuehn, D. P., & Moll, K. L. (1976) A cineradiographic study of VC and CV articulatory velocities. *Journal of Phonetics*, 4, 303-320.
- Kuperus, J. (1978) *Esquisse du système verbal de l'oro du Nigeria*. Thèse de IIIe cycle, Sorbonne, Université Paris V - René Descartes.
- Labov, W. (1972) *Sociolinguistic Patterns*. Oxford: Basil Blackwell.
- Labov, W. (1981) Resolving the Neogrammarian controversy. *Language*, 57, 267-308.
- Ladefoged, P. (1964) *A Phonetic Study of West African Languages: an auditory-instrumental survey*. Cambridge: Cambridge University Press.
- Ladefoged, P. (1982) *A Course in Phonetics* (2nd ed.). New York: Harcourt Brace Jovanovich.
- Lass, N. J. (1980) *Speech and Language: Advances in Basic Research and Practice*. New York: Academic Press.
- Lass, R. (1978) On climbing down trees without falling out. In J. Fisiak (Ed.), *Recent Developments in Historical Phonology* Berlin: Mouton.
- Lass, R., & Higgs, J. (1984) Phonetics and language history: American /r/ as a candidate for an archaism. In J. W. Higgs, & R. Thelwall (Eds.), *Topics in Linguistic Phonetics. In Honour of E.T. Uldall* (pp. 91-109). Coleraine: New University of Ulster.
- Laver, J. D. (in press) *Principles of Phonetics*. Cambridge: Cambridge University Press.
- Lehiste, I. (1959). *An acoustic study of internal open juncture*. Speech Research Laboratory, Ann Arbor.
- Lehmann. (1962) *Historical Linguistics: an introduction*. New York: Holt, Rinehart and Winston.

- Lehmann, W. (1967) *A Reader in Nineteenth Century Historical Indo-European Linguistics*. Bloomington: Indiana University Press. (trans. by W. Lehmann.)
- Lieberman, P. (1967) *Intonation, Perception and Language*. Cambridge, Mass: MIT Press.
- Lisker, L., & Abramson, A. (1964) A cross-language study of voicing in initial stops: acoustic measurements. *Word*, 20, 384-422.
- Löfqvist, A., & Yoshioka. (1981) Interarticulator programming in obstruent production. *Phonetica*, 38, 21-34.
- MacNeilage, P. F. (1983) *The Production of Speech*. New York: Springer.
- Maddieson, I. (1984) *Patterns of Sounds*. Cambridge: Cambridge University Press.
- Martinet, A. (1955) *Economie des changements phonétique*. Berne: Franck.
- Matisoff, J. (1973) Tonogenesis in Southeast Asia. In L. Hyman (Ed.), *Consonant Types and Tone (Southern California Occasional Papers in Linguistics 1)* (pp. 71-96). Los Angeles: University of Southern California.
- Meillet, A. (1966) *La méthode comparative en linguistique historique*. Paris: Champion.
- Meyer-Lübke, W. (1890-1906) *Grammaire des Langues Romanes*. Paris. (translated from German).
- Miehe, G. (1985) /L/ and /n/ in Benue-Congo, *Afrika und Übersee, Band 68, Heft 2*, 233-278.
- Milroy, J., & Milroy, L. (1985) Linguistic change. *Journal of Linguistics*, 21, 339-384.
- Noss, P. A. (1976) Sambo Leeko: outline of phonology. *Bulletin de l'Atlas Linguistique de Cameroun*, 2, 7-38.
- Ohala, J. J. (1971) The role of physiological and acoustic models in explaining the direction of sound change. *Project on Linguistic Analysis, Second Series, No. 15*, 25-40.
- Ohala, J. J. (1974a) Experimental historical phonology. In J. M. Anderson, & C. Jones (Eds.), *Historical Linguistics II: theory and description in phonology. Proceedings of the 1st International Conference on Historical Linguistics, Edinburgh, 1973* (pp. 353-389). Amsterdam: North-Holland.
- Ohala, J. J. (1974b) Phonetic explanation in phonology. In A. Bruck, R. A. Fox, & M. W. La Galy (Eds.), *Papers from the Parasession on Natural Phonology* (pp. 251-274). Chicago: Chicago Linguistic Society.
- Ohala, J. J. (1978) Southern Bantu vs. the world: the case of palatalization of labials. *Report of the Phonology Laboratory, Berkeley*, 2 May 1978, 47-62.
- Ohala, J. J. (1979) *Universals of labial velars and de Saussure's chess analogy*.



- Copenhagen: University of Copenhagen, 41-47.
- Ohala, J. J. (1980) The application of phonological universals in speech pathology. In N. J. Lass (Ed.), *Speech and Language: Advances in Basic Research and Practice*. (pp. 75-97). New York: Academic.
- Ohala, J. J. (1981) The listener as a source of sound change. In C. S. Masek, R. A. Hendrick, & M. F. Miller (Eds.), *Papers from the Parasession on Language and Behavior* (pp. 178-203). Chicago: Chicago Linguistic Society.
- Ohala, J. J. (1983) The origin of sound patterns in vocal tract constraints. In P. F. MacNeilage (Ed.), *The Production of Speech* (pp. 189-216). New York: Springer.
- Ohala, J. J. (1986) Phonological evidence for top-down processing in speech perception. In J. S. Perkell, & D. H. Klatt (Eds.), *Invariance and Variability in Speech Processes* (pp. 386 - 401). Hillsdale, N.J.: Lawrence Erlbaum Associates.
- Ohala, J. J. (1987) Explanation in phonology: opinions and examples. In W. Dressler *et al* (Eds.), *Phonologica 1984: proceedings of the 5th International Phonology Meeting, Eisenstadt, June 1984*. (pp. 215-225) London CUP.
- Ohala, J. J. (1989) Sound change is drawn from a pool of synchronic variation. In L. E. Breivik, & E. H. Jahr (Eds.), *Language Change: Contributions to the study of its causes* (pp. 173-198). Berlin: Mouton de Gruyter.
- Ohala, J. J. (1990a) *Alternatives to the Sonority Hierarchy for Explaining Segmental Sequential Constraints*. Chicago: Chicago Linguistics Society,
- Ohala, J. J. (1990b) There is no interface between phonetics and phonology: a personal view. *Journal of Phonetics*, 18, 153-171.
- Ohala, J. J., & Kawasaki, H. (1984) Prosodic phonology and phonetics. *Phonology Yearbook*, 1, 113-127.
- Ohala, J. J., & Lorentz, J. (1978) The story of [w]. *Report of the Phonology Laboratory, Berkeley*, 2 (May 1978), 132-155.
- Ohala, J. J., & Riordan, C. J. (1979) Passive vocal tract enlargement during voiced stops. In J. Wolf, & D. Klatt (Eds.), *Speech Communication Papers* (pp. 89-92). New York: Acoustical Society of America.
- Öhman, S. E. G. (1966) Coarticulation in VCV Utterances: spectrographic measurements. *Journal of the Acoustical Society of America*, 39 1, 151-168.
- Osthoff, & Brugmann, K. (1967 (1878)) Morphological investigations in the sphere of the Indo-European languages (preface). In W. Lehmann (Ed.), *A Reader in Nineteenth Century Historical Indo-European Linguistics*. Bloomington:



Indiana University Press.

- Pagliuca, W. (1982) *Prolegomena to a Theory of Articulatory Evolution*. PhD, SUNY, Buffalo.
- Pagliuca, W., & Mowrey, R. (1980) On certain evidence for the feature [grave]. *Language*, 56, 503-14.
- Pagliuca, W., & Mowrey, R. (1987) Articulatory evolution. In A. C. Ramat (Ed.), *Proceedings of the VII International Conference of Historical Linguistics*. (pp. 459-472). Amsterdam: Johns Benjamin.
- Painter, C. (1978) Implosives, inherent pitch, tonogenesis, and laryngeal mechanisms. *Journal of Phonetics*, 6, 249-274.
- Paul, H. (1888) *Principles of the History of Language* (2nd ed.). London: Swan Sonnenschein and Lowrey. (trans. by H.A. Strong.)
- Peeters, C. (1988) Phonemic reconstruction: why and how? *Belgian Journal of Linguistics*, 3, *Phonological Reconstruction: problems and methods*, 9-15.
- Pike, K. L. (1943) *Phonetics*. Ann Arbor: University of Michigan Press.
- Pike, K. L. (1967) *Language in Relation to a Unified Theory of the Structure of Human Behavior*. The Hague: Mouton.
- Puesch, G. (1989) *L'Opposition Implosive/Mi-voisées en Bekwil*. Leiden, The Netherlands: Paper presented to the 20th CALL.
- Ramat, A. C. (Ed.) (1987) *Proceedings of the VII International Conference of Historical Linguistics*. Amsterdam: Johns Benjamin.
- Recasens, D. (1984a) V-to-C coarticulation in Catalan. *Journal of Phonetics*, 12, 61-73.
- Recasens, D. (1984b) Timing constraints and coarticulation: alveolo-palatals and sequences of alveolar + [j] in Catalan. *Phonetica*, 41, 125-139.
- Recasens, D. (1986) *Estudis de Fonètica Experimental del Català Oriental Central*. Barcelona: Publicacions de l'Abadia de Monserrat.
- Recasens, D. (1990) The articulatory characteristics of palatal consonants. *Journal of Phonetics*, 18, 267-280.
- Repp, B. H. & Lin, H.-B. (1990) Integration of segmental and tonal information in speech perception: a cross-linguistic study. *Journal of Phonetics*, 18, 481-495.
- Ruhlen, M. (1976) *A Guide to the Languages of the World*. Stanford.
- Sagey, E. (1986) *The Representation of Features and Relations in Non-linear Phonology*. PhD, MIT.
- Saussure, F. d. (1974) *Course in General Linguistics*. Glasgow: Fontana/Collins.
- Selkirk, E. O. (1982) The syllable. In H. v. d. Hulst, & N. Smith (Eds.), *The*

*Structure of Phonological Representations Pt. II* Dordrecht: Foris.

- Sherman, D. (1975) Stops and fricative systems: a discussion of paradigmatic gaps and the question of language sampling. *Working Papers on Language Universals* (Stanford), 17, 1-31.
- Simmons, D. C. (1956) Oron verb morphology. *Africa*, 26, 250-268.
- Simmons, D. C. (1957) Ibibio verb morphology. *African Studies*, 16, 1-19.
- Simmons, D. C. (1965) Oron noun morphology. *Journal of West African Languages*, II No. 2, 33-37.
- Simmons, D. C. (n.d.) *Notes on Eket Verb Morphology*. Unpublished mss; (author unattributed, but probably Simmons),
- Slis, I. H., & Berg, R. J. H. v. d. (1985) Perception of assimilation of voice. *Proceedings (Institute of Phonetics, University of Nijmegen)*, 9, 18-25.
- Stampe, D. (1969) The acquisition of phonetic representations. *Papers from the 5th Regional Meeting* (pp. 443-454). Chicago: Chicago Linguistic Society.
- Stampe, D. (1979) *A Dissertation on Natural Phonology*. New York: Garland Press.
- Sterk, J. (1979) Fortis/lenis contrast in Upper Cross consonants: a survey. *Kiabàrà*, 2 (Harmattan) 2, 57-68.
- Sterk, J. S. (n.d.) *Reconstruction of Proto Upper Cross*. (Unpublished mss.).
- Stewart, J. (1989) Fortis/lenis and vowel length in Proto-Bantu. *Journal of African Languages and Linguistics* II No. 1, 45-88.
- Straka, G. (1965) *Album Phonétique*. Québec: Les Presses de l'Université Laval.
- Suomi, K. (1980) *Voicing in English and Finnish Stops: a typological comparison*. Turku: University of Turku.
- Traill, A. (1985) *Phonetic and Phonological Studies of !Xóõ Bushman*. Hamburg: Helmut Buske.
- Uldall, E. T. (1974) Some remarks on the Japanese variphone r, [l], and the concept of "free variation". *World Papers in Phonetics, Festschrift for Dr. Onishi's KIJU, Phonetic Society of Japan* (pp. 505-517).
- Urua, E. E. (1990) *Aspects of Ibibio Phonology and Morphology*. PhD, University of Ibadan,
- Vincent, N. (1978) Is sound change teleological? In J. Fisiak (Ed.), *Recent Developments in Historical Phonology* (pp. 409-430). Berlin: Mouton.
- Wang, W. (1969) Competing changes as a cause of residue. *Language*, 45, 9-25.
- Ward, I. C. (1933) *The Phonetic and Tonal Structure of Efik*. Cambridge: W. Heffer & Sons Ltd.
- Weinreich, U., Labov, W., & Herzog, M. (1968) Empirical foundations for a theory of language change. In W. Lehmann, & Y. Malkiel (Eds.), *Directions for*

- Historical Linguistics: a symposium* (pp. 95-188). Austin: University of Texas Press.
- Weismer, G. (1980) Control of the voicing distinction for intervocalic stops and fricatives: some data and theoretical considerations. *Journal of Phonetics*, 8, 427-438.
- Welmers, W. (1966) *Efik*. Obot Idim (Uyo): Lutheran Mission; also published in 1968 by the Institute of African Studies, Occasional Publication No. 11, University of Ibadan.
- Welmers, W. (1973) *African Language Structures*. Berkeley: University of California Press.
- Westbury, J. R. (1983) Enlargement of the supraglottal cavity and its relation to stop consonant voicing. *Journal of the Acoustical Society of America*, 73, 1322-1336.
- Westbury, J. R. & Keating, P. (1986) On the naturalness of stop consonant voicing. *Journal of Linguistics*, 22, 145-166.
- Westermann, D. & Ward, I. C. (1933) *Practical Phonetics for Students of African Languages*. London: Oxford University Press (for the International African Institute).
- Williamson, K. (1977) Multivalued features for consonants. *Language*, 53, 843-871.
- Williamson, K. (1989) Niger-Congo Overview. In J. Bendor-Samuel (Ed.), *The Niger-Congo Languages*. University Press of America.
- Williamson, K. (n.d.) A Preliminary Reconstruction of Proto-Ogoni (unpublished mss).
- Winston, F. D. D. (1960) The 'mid' tone in Efik. *African Language Studies*, 1, 185-192.
- Winston, F. D. D. (1970) Some Bantu-like features of Efik structure. *African Languages Studies*, 11, 417-435.
- Wolff, H. (1969) *A Comparative Vocabulary of Abuan Dialects*. Evanston: Northwestern University Press.
- Zue, V. W. (1980) *Acoustics Characteristics of Stop Consonants: a controlled study*. Bloomington: Indiana University Linguistics Club.